MINOR SURGERY

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THIS BOOK IS PRODUCED IN COMPLETE CONFORMITY WITH THE AUTHORIZED ECONOMY STANDARDS

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Made and Printed in Great Britain

PREFACE TO THIRD EDITION

It is not an easy task to define precisely the limits of "minor" surgery, and the author is conscious that this little manual is open to criticism in that it is either incomplete, or that it contains matter which deals with major rather than minor surgery However, it is intended to be a guide to hospital residents, and an aid to practitioners who, from choice or necessity feel called to deal with minor surgical problems or common surgical emergencies

I am indebted to my friends and collaborators for their assistance in revising chapters of which they have special experience and to those who in the previous edition deputised for colleagues who were then serving in the Forces Dr Denise Pullen has again been meticulous in reading the proofs Finally I must express my grateful thanks to the publishers for their constant help and patience expended in the production of *Minor Surgery*

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MINOR SURGERY

CHAPTER I

EXAMINATION OF THE PATIENT

History

A carefully taken history is of great importance, especially in such conditions as gastric and duodenal ulcer or cholelithiasis, in which physical signs may be completely absent

It should include, amongst other things, the age of the patient occupation and if a woman the condition of the catamenia, number of children, and miscarriages

Inspection

The often repeated and on the whole sound advice of 'eyes first and hands after' is to be remembered A pocket torch is necessary for examining throats and testing for translucency and transillumination

The patient's position should be noted and is sometimes characteristic. If suffering from cervical caries, he will hold the neck stiffly with the head projecting slightly forwards, and the chin may be supported in his hands whilst if psoas spasm is present e g some cases of acute appendicitis, he will keep the hip joint flexed, so that when walking he bends forwards and when lying he draws the knee up on the affected side Other points of which the surgeon may note include jaundice anæmia cachexia, recent wasting obvious swellings such as thyroid enlargement, exophthalmos

ptosis palpebræ unequal pupils and movement of the alæ nasi

Some conditions are easier to see than to palpate, as for example gastro intestinal peristalsis

Whenever possible, during the examination of a part it is important to have its fellow of the opposite side exposed for purposes of comparison This especially applies in the case of the limbs joints and breasts If one knee joint is affected the two lower extremities are compared to determine the presence of swelling position of ease limitation of movement muscular wasting and alteration in length (Fig 1)

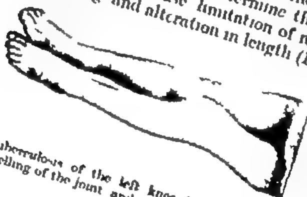


Fig 1—Tuberculosis of the left knee joint showing flexion swelling of the joint and wasting of muscles

PALPATION

When a swelling is palpated the following points must be systematically noted site size shape attachments to surrounding structures consistency (including pulsation and transillumination) and sensitivity If considered necessary the regional glands are palpated and a general examination of the patient sometimes provides a clue as to the nature of the swelling

To consider two examples A patient a female twenty years of age presents herself with a swelling in the breast

Site, lower and outer quadrant of the left breast

Size, large cherry

Shape, smooth and rounded

Attachments, not attached to the skin or deep fascia, and freely mobile in the adjacent breast tissue

Consistency, hard and opaque to transillumination

Sensitivity, painless

The diagnosis of such a condition would be a hard fibro adenoma

Another example is a man sixty years of age, who has noticed a swelling on the left side of the neck for three months

Site, below and behind the angle of the left jaw Less apparent when the sterno mastoid muscle is contracted, so it is beneath the muscle

Size, pigeon's egg

Shape, somewhat irregular

Attachments, not attached to the skin, but adherent to deep structures

Consistency, firm

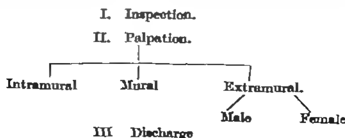
Sensitivity, painless

The physical signs suggest secondary carcinoma of the upper cervical glands Examination of the mouth is negative, but laryngoscopy reveals a small and symptomless carcinoma of the pyriform fossa

RECTAL EXAMINATION

This procedure is sometimes of paramount importance and must be conducted in a thoughtful manner Pushing a finger into the anal canal and momentarily waiting for an inspiration is to be deprecated !

A systematic rectal examination is conducted as follows



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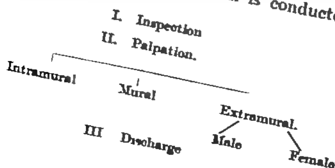
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A systematic rectal examination is conducted as follows



The following are some of the commoner conditions which are likely to be confirmed or discovered when a rectal examination is properly conducted

Inspection

The patient lies on the left side with the light suitably arranged and the buttocks are separated A thrombosed pile presents itself as a tense, tender purplish swelling Internal piles may be prolapsed or visible on straining Puckering of the anal margin, due to spasm of the sphincter possibly associated with a sentinel "pile" are diagnostic of a fissure The *opening of an external fistula* may be visible, or excoriation of the skin in a case of pruritus ani Prolapse of the mucus membrane is not uncommon in children and is to be distinguished from the apex of an intussusception (rare) Obviously, in the former case the prolapsed mucosa is continuous with the skin of the anal margin

Palpation

Protected by a lubricated glove or finger stall the index finger is introduced into the anal canal care being taken that gentle pressure is exerted by the pulp of the finger while the patient quietly strains In some cases of fissure the pain and spasm are so intense that *the introduction of a finger is impossible* The following conditions are usually easily recognised

Intramural, fæcal impaction (the lump can be indented), a rectal polyp foreign body or the apex of an intussusception

Mural, carcinoma, stricture submucous abscess, indurated opening of an internal fistula villous papilloma

Extramural

(*a*) *Male* simple enlargement of the prostate, carcinoma of the prostate either nodular or scirrhus,

prostatitis or prostatic abscess tuberculous nodules of prostate or seminal vesicles, abscess of Cowper's glands

(b) *Female* enlargement of uterus, ovarian cyst swellings in the fornices, secondary deposits or swellings in the pouch of Douglas

If the patient strains while in the squatting position, another half an inch of rectum is brought down to within reach of the examining finger

Discharge

When the finger is withdrawn it should be wiped on a swab and any discharge inspected Bright red blood would indicate internal hæmorrhoids or a villous papilloma, pus suggests an internal fistula while bloody slime' (blood pus and mucus) is commonly associated with a malignant growth In the case of an intussusception red currant jelly' (blood and mucus) is almost diagnostic

INVESTIGATION OF AN ACUTE ABDOMEN'

History —After noting the age and sex the first question to ask is, How long has the patient been ill and was he quite well before? The next What was the first symptom? If *pain* did it come on suddenly as in a perforated gastric or duodenal ulcer (when the patient usually knows the exact time of onset) or gradually even though rapidly increasing in intensity as in acute appendicitis is it constant or intermittent and colicky as in intestinal obstruction its position at onset and its present position? If due to acute appendicitis it frequently starts in the neighbourhood of the umbilicus or all over the abdomen then settles in the right iliac fossa.

A previous history of indigestion due to gastric or duodenal ulcer colicky pains and rumblings of chronic obstruction the flatulent dyspepsia of gall

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Extramural

(*a*) *Male* simple enlargement of the prostate carcinoma of the prostate either nodular or scirrhus,

stones, or of an attack of acute appendicitis may confirm a suspected diagnosis

Vomiting is considered next as to the time of onset frequency, character, and quantity Thus in the case of a perforated peptic ulcer vomiting may be absent or occur only once or twice whereas acute pancreatitis is associated with frequent and progressive vomiting Acute intestinal obstruction is characterised by the vomiting of gastric contents followed a few hours later by bile-stained fluid if the obstruction is unrelieved the fluid becomes brownish in colour and foul in smell—the so called 'fæcal vomiting' In one type of acute obstruction—obturation of the ileum by an impacted gall stone—persistent vomiting is the only feature during the early stages and the condition should always be suspected when an elderly female vomits for more than a few hours for no apparent reason

The condition of the bowels may have an important bearing in the case A previous history of alternating constipation and diarrhœa suggests the supervention of acute on a chronic obstruction—most commonly a 'ring' carcinoma of the colon Constipation and diminishing quantities of flatus are features in most cases of acute intestinal obstruction but if the lumen of the bowel is only partly obliterated as in a Richter's hernia the passage of fæces is uninterrupted 'Red currant jelly' stools are commonly associated with an acute intussusception and the passage of foul smelling blood should suggest the possibility of thrombosis of mesenteric veins

Examination

General – The appearance of the patient is noted especially with regard to position facial expression and tongue Increased respirations with movement of the alæ nasi suggest a pulmonary condition Increased pulse rate and pallor are to be expected in a

case of a ruptured ectopic gestation, while a high temperature (102° F or more) indicates an inflammatory lesion such as acute salpingitis or possibly acute appendicitis, although it must be borne in mind that in the latter condition the temperature may vary from subnormal to a moderate elevation

Abdomen

(*a*) *Inspection* Movement on respiration is best noted if the examiner stands at the foot of the bed absence or diminution of movement suggests an inflammatory condition Distension is either central (small bowel), lateral (large bowel) or localised, such as a ballooned cæcum in colonic, rectal, or even anal obstruction Visible peristalsis may be noted, and the presence of previous operation scars suggests the possibility of abdominal adhesions Needless to say the region of the hernial orifices are included in any inspection of the abdomen

(*b*) *Palpation*, with a warm hand, and conducted by flexing the metacarpo phalangeal joints, will reveal any generalised or localised tenderness and rigidity A localised swelling may be detected, such as a carcinoma of the colon or a ballooned cæcum An enlarged and probably irregular liver will suggest secondary deposits associated with a primary growth in the portal area Scars especially in obese patients are palpated in order to discover or exclude a strangulated incisional hernia Umbilical or inguinal herniæ are unlikely to escape detection or inspection but a femoral hernia is often only discoverable on careful palpation and even then a Richter's hernia in an obese female may escape recognition

Hyperæsthesia should be tested for by gently drawing a pencil over the skin The common pin is apt to cause apprehension especially in the case of children so that a painful stimulus is a foregone conclusion in the mind of the patient Hyperæsthesia is associated

with distension of a hollow viscus Thus in the case of an unruptured and obstructed appendix, hyperæsthesia is present over Sherren's triangle while if acute cholecystitis is present, hyperæsthesia may be elicited in the region of the lower angle of the right scapula

(c) *Percussion* is a valuable test for free fluid in the peritoneal cavity Shifting dullness can usually be demonstrated in cases of ascites i e percussion near the mid line yields a resonant note but when the patient rolls on the appropriate side the note over the same area is dull Shifting dullness is sometimes detected in cases of recent intraperitoneal hæmorrhage Enlargements of solid organs can usually be detected by percussion such as physiological or pathological enlargement of the uterus and hepatic or splenic enlargements Diminution of liver dullness is alleged to occur in cases of perforation of the bowel or stomach Gastric or cæcal distension is readily detected and in cases of gross intestinal distension such as occurs in ileus or the late stages of general peritonitis a tympanitic note is characteristic

Percussion is sometimes useful in distinguishing the contents of a strangulated hernia A resonant note indicates the presence of gut whereas dullness suggests that the strangulated contents are omentum (an epiplocele)

(d) *Auscultation* which is of special importance as distinguishing between a mechanical obstruction and ileus or paralysis of the bowels In the former case peristalsis is active and a stethoscope reveals characteristic tinkling sounds due to the ebb and flow of gas and fluid as waves of peristalsis endeavour to propel the intestinal contents past the obstruction On the other hand a silent abdomen is typical of ileus Auscultation is sometimes useful in estimating the degree of distension of a hollow viscus such as the stomach or cæcum The stethoscope is held over the distended viscus and percussion within the limits of

the organ is readily conducted to the ear, but the note is lost when percussion is performed beyond the organ under examination

Auscultation over an aneurysm commonly reveals a characteristic bruit, and this physical sign may clinch the diagnosis in a suspected case of cœliac or splenic aneurysm

(e) *Pelvic examination* It must always be remembered that the lower region of the peritoneal cavity is palpable by either the rectum or vagina Rectal examination has already been considered, but in the case of a non virginal female a vaginal examination gives even better access to the pouch of Douglas The uterus and adnexa are easily palpable, a thickened ureter or a ureteric calculus can sometimes be detected, and abnormal structures in the pouch of Douglas such as secondary deposits, a prolapsed carcinoma of the pelvic colon, or a gall stone impacted in the ileum are occasionally recognised

(f) *Other investigations* In doubtful cases examination of the chest may discover pleuro pneumonia, which sometimes causes reflex abdominal rigidity, or a cardiac lesion such as mitral stenosis which is apt to give rise to a mesenteric embolus Examination of the pupils and knee jerks will exclude a gastric or rectal crisis The onset of uræmia is sometimes associated with abdominal symptoms due to ileus, and an inadequate urinary output, or urine of low specific gravity should raise the suspicion of renal inefficiency

In cases of doubtful acute intestinal obstruction a soap and water enema should be given, and thus the lower bowel is emptied One hour later the enema is repeated, and in most cases of obstruction this will be returned without force fæces or flatus Two notable exceptions are obturation of a gall stone in the ileum, and a Richter's hernia (with the latter condition is included a Littré's hernia, i.e herniation of a Meckel's diverticulum) In these cases the lumen of the bowel

is not completely occluded so some of the intestinal contents can negotiate the obstruction In cases of acute pancreatitis an increased amount of diastase is present in the urine The normal amount is 20–40 units and this may be increased tenfold However other acute abdominal conditions such as general peritonitis, also cause a rise in the diastatic index Loewi's mydriatic test is of some value in cases of acute pancreatitis, and consists in instilling a few drops of 1 1000 adrenalin into one conjunctival sac This is repeated five minutes later and if positive the corresponding pupil will dilate within half an hour of the administration

The following is a summary of the more important features in some common cases of the "acute abdomen"

Perforated gastric ulcer —The history may suggest previous dyspeptic disturbances and in any case the patient knows exactly when the catastrophe occurred During the first few hours the patient is immobilised with pain respirations are thoracic the expression is anxious and the hair is lank with sweat The pulse rate may be slightly increased and temperature normal or subnormal Abdominal examination reveals lack of movement with generalised tenderness and rigidity After a period of from four to twelve hours the period of delusion supervenes (a case is reported in which during this period a bridegroom felt sufficiently recovered to attend his wedding!) During this interval the patient looks and feels better pain diminishes in intensity but the pulse rate is invariably somewhat raised Both the patient and the medical practitioner may be deluded during this interval in imagining that whatever may have been the cause of the sudden illness the crisis has passed, but the history of the onset and the raised pulse rate should prevent mistaken diagnosis

From twelve hours onwards peritonitis develops

apace The patient complains of abdominal pain of a "tearing" or "bursting" character, vomiting supervenes and becomes insistent, the pulse rate steadily rises and the temperature fluctuates In the early stages abdominal rigidity and tenderness are evident, but if time is allowed to pass without surgical intervention, the abdomen gradually becomes distended and eventually tympanitic, with possible loss of liver dullness Finally, the Hippocratic facies portends the approach of the end—anxious expression, clammy forehead, sunken eyes pinched nose, hollow cheeks, and sordes on the drying lips The pulse is rapid and "thready" temperature is subnormal, the stomach frequently regurgitates small quantities of dark, foul fluid but often the patient remains mentally alert until he is summoned to the Styx

Perforation of a duodenal ulcer is often associated with less collapse, and pain not so agonising as that caused by a perforated gastric ulcer In the latter case (unless rupture occurs into the lesser sac) the gastric contents are forcibly ejected into and flood the general peritoneal cavity whereas the duodenum is comparatively empty and escaping contents, in the early stages collect in Rutherford Morrison's pouch and the right paracolic gutter This explains why perforation of a duodenal ulcer is sometimes mistaken for acute appendicitis, as fluid trickles along the paracolic gutter into the right iliac fossa, where the resulting peritoneal irritation closely simulates the signs of appendicular inflammation However the abruptness of the onset in the case of a duodenal ulcer and associated subcostal tenderness and rigidity should put the clinician on his guard

An anastomatic ulcer occasionally perforates but as the ulcer is tucked away under the transverse meso colon and probably surrounded by adhesions the clinical features are less dramatic than those associated with rupture of a gastric or duodenal ulcer

However, the knowledge that a gastro-enterostomy has been performed, together with the abrupt onset of the illness, are usually sufficient to suggest the diagnosis

Strangulated hernia.—Internal herniæ such as those occurring in intraperitoneal fossæ, sciatic notch or obturator foramen, are unlikely to be diagnosed except as acute obstruction, although in the case of an obturator hernia pain may be referred to the corresponding knee

Strangulation of an external hernia is the commonest cause of acute obstruction and obviously the hernial orifices must be carefully examined in all obstructed cases With the exception of a Richter's hernia (page 7) the diagnosis of a strangulated hernia is obvious The patient may have been aware of a pre-existing hernia and in any case the onset is more or less abrupt and commonly associated with muscular effort a cough or sneeze, or a minor accident such as slipping on the stairs On examination of the hernial sites a swelling is found which is tense tender and from which the cough impulse is absent Percussion may help in deciding whether the sac contains bowel or omentum If strangulation involves the bowel the symptoms and signs of acute obstruction will shortly supervene Strangulation of the omentum appendix or a Fallopian tube is commonly associated with reflex vomiting but evidence of acute obstruction is wanting

Treatment of a strangulated hernia is discussed on page 188

Intussusception—This is the commonest cause of acute obstruction in a child usually a male under the age of one year Weaning and unsuitable diet are apt to cause enteritis This in turn results in swelling of Peyer's patches and increased peristalsis Consequently a projecting Peyer's patch is caught up in a wave of peristalsis drawn into the lumen of the bowel

and so forms the starting point of an intussusception The affected child, who was previously healthy, is seized with sudden abdominal pain, which passes off in a few moments only to return in increasing severity at intervals of about five to ten minutes Vomiting commonly occurs during the spasms of pain The child usually dozes or even sleeps between the paroxysms and after a few hours the motions become blood-stained

Examination reveals some degree of collapse depending on the duration and severity of the condition The golden rule of all physical examinations "eyes first and fingers last" is now broken as palpation should be performed between the attacks of pain while the child is sleeping Therefore a warm hand is quietly insinuated beneath the bedclothes, and the examiner is commonly rewarded by discovering through the flaccid abdominal wall a sausage-shaped swelling Palpation initiates a wave of peristalsis so that the swelling can be felt to become smaller and firmer The associated colicky pain awakens the child but now the diagnosis is assured Absence of a swelling does not negative the diagnosis as the intussusception may have reached the region of the hepatic flexure and so is hidden by the liver Alternatively it may have passed along into the pelvis in which case it will be detected on rectal examination Irrespective of the site of the intussusception blood and mucus are likely to be found on the finger following a rectal examination

If the child is too restless to tolerate adequate palpation or if the result of the examination is doubtful, it may be wise to administer an anæsthetic in order to carry out a thorough and unhampered investigation

If the diagnosis is established, a sedative should be administered without delay This will diminish peristalsis and so hinder further impaction and also

relieve pain which is such a potent contributory cause of shock (N B —In all abdominal emergencies a sedative e g morphine or omnopon should be administered as soon as it has been agreed that an *operation is necessary*)

Routine Examinations

For the use of students in particular it is well to emphasise that as far as possible routine methods of examination should be adopted so that important points are not omitted The instances given below will serve as examples

An Ulcer

Site e g 95 per cent of rodent ulcers occur on the face and forehead above a line joining the ala of the nose and the lower border of the ear Carcinoma affects the lower lip while a primary chancre is usually on the upper

Size, particularly in relation to the length of history e g a carcinoma extends more rapidly than a rodent ulcer but more slowly than an inflammatory ulcer

Shape e g a rodent ulcer remains circular until of a larger size than a carcinoma It is stated that a rodent ulcer only becomes irregular when it encroaches on an area of skin possessing a different sensory nerve supply, when temporary arrest occurs A gummatous ulcer is typically circular or serpiginous due to the fusion of multiple circles

Edge a rodent ulcer is rolled or rampart (Fig 3) an epithelioma everted while a tuberculous ulcer has an undermined edge (Fig 2)

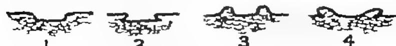


Fig 2.—1 Healing ulcer edges shelving 2 Tuberculous ulcer 3. Rodent ulcer 4 Epithelioma.



FIG 3.—A rodent ulcer of five years duration showing typical rampart edge

Floor a "wash leather" slough may cover the floor of a gummatous ulcer while a tuberculous ulcer often exhibits watery granulations

Base, whether indurated e g infiltration of carcinoma, or attached to deep structures, e g a varicose ulcer to the tibia

Glands not enlarged in the case of a rodent ulcer unless due to infection May be hard and fixed in the case of carcinoma or shotty if their enlargement is due to a primary chancre

Discharge whether gummatous, watery or sanious Organisms may be detected e g spirochætes, tubercle bacilli actinomycosis

General examination of the patients sometimes provides a clue as to the nature of the ulcer Thus if a tertiary syphilitic ulcer is suspected examination of the mouth may reveal other stigmata, such as perforation of the hard palate, partial destruction of the soft palate other gummatous lesions or chronic superficial or parenchymatous glossitis "Tissue paper" scars, which are circular or serpiginous silvery and supple are typical of healed gummatous ulcers Similarly a tuberculous ulcer may be associated with other tuberculous manifestations, either active quiescent, or apparently cured

Accessory investigations provide the final aids to diagnosis In doubtful cases a portion of the ulcer edge together with a small piece of surrounding

healthy tissue, is excised and submitted to microscopical scrutiny

The Wassermann reaction for syphilis, and dermal tests for tuberculosis are valuable in selected cases

Classification of Ulcers

Ulcers are either non-specific, specific or malignant For example, a summary of ulcers which occur on the tongue —

I Non-specific—traumatic dyspeptic dental herpetic

II Specific—(a) Syphilitic, primary chancre Secondary ' snail track ' Tertiary gummatous (b) Tuberculous usually associated with advanced phthisis

III Malignant—(a) Primary (b) Secondary, to such conditions as chronic superficial glossitis or a dental ulcer

A Joint

Inspection, which is carried out in an adequate light with the corresponding joint uncovered and placed in a similar position for purposes of comparison Inspection will reveal any deformity e g triple deformity ' of an old tuberculous knee, which is flexed, subluxated backwards, the foot being externally rotated Wasting of muscles is always present in the case of tuberculous joints Swelling may be obvious, either distension of the joint cavity as in the case of Charcot s disease or fusiform from synovial and peri articular œdema, so typical of tuberculous joints Abnormal swellings may be seen such as Baker s cysts due to protrusion of the synovial membrane through the capsule They are encouraged by intermittent distension of the joint, and are therefore particularly liable to occur in chronic osteo arthritis and Charcot s disease (Fig 4)



FIG 4—A Baker's cyst associated with osteo-arthritis of the wrist joint The patient had been digging daily for forty years.

Palpation, which may confirm a diagnosis of dislocation in that an articular end of a bone is found in an abnormal position Tenderness in the region of the joint, and the temperature of the skin, are also noted The presence of fluid may be detected, e g by the "patellar tap" in the case of the knee joint Palpation of the knee joint must always include the popliteal fossa, otherwise such conditions as Baker's cysts or enlarged bursæ will be overlooked

Movements the patient should first endeavour voluntarily to move the affected joint the degree of movement and condition of adjacent muscles being noted The sound joint is then put through its full range of movements which manœuvre allays nervousness of the patient and forms a standard of comparison The affected limb is then moved in appropriate directions, and any limitation of or additional, movement e g telescopic hip is recognised Pain on movement may occur only in certain directions and this is often of diagnostic value for example, in the case of inflammation of the subdeltoid bursa abduction of the arm is painful, whereas rotatory movements cause no pain this feature distinguishes subdeltoid

bursitis from arthritis of the shoulder joint, in which case all movements are painful

Grating on movement is typical of chronic osteo arthritis, and is due to erosion of the cartilage on pressure points In the case of Charcot's joints a painless soft crepitus is often detected similar to the "crunching" produced when snow is compressed

Measurement, which confirms wasting of muscles or swelling of the joint Alteration of the length of the limb can be accurately estimated and in the case of the hip joint the base of Bryant's triangle should be measured

General Examination which may confirm the tentative diagnosis of the joint condition Thus absent knee jerks and the presence of Argyll Robertson pupils will support a diagnosis of Charcot's joint Other evidence of syphilis or tuberculosis may be found if joints are affected by these conditions

Special Examinations, which include X ray, aspiration and examination of fluid and possibly excision of a regional gland in a case of suspected tuberculosis

A Breast

Inspection which is carried out with both breasts exposed, the patient sitting in a good light the hands resting on the knees Any obvious swelling or alteration of the contour of the breast is noted also the relative position of the nipples Eczema around the nipple or changes in the skin may be present, e.g dilated veins puckering peau d orange, or even ulceration

Palpation which is performed with the patient lying down and should first be directed to the opposite breast as an unsuspected condition may thus be recognised and some conditions, notably chronic interstitial mastitis are occasionally bilateral The affected breast is then palpated and if a swelling is

detected its size, shape, consistency tenderness are noted, and also its relation to the skin and pectoral fascia the pectoralis muscle being actively contracted to enable this last observation to be made If the swelling is in the lower or outer part of the breast transillumination is often valuable in distinguishing between a cyst and a neoplasm The breast should be gently massaged in the direction of the nipple and the character of the discharge if any, is noted

General Examination, which includes axillary and supraclavicular glands the opposite breast thorax and abdomen if carcinoma is suspected If "rheumatism" or lumbago" is complained of examination of the affected part or an X ray may reveal a secondary deposit in a long bone or the spine

Exploration, which should always be adopted unless malignancy can be definitely excluded

A Scrotal Swelling

Inspection, noting the size of the swelling and the presence of dilated veins or sinuses If sinuses are present their position is important as unless the testicle is anteverted, a gumma breaks down in front while a tuberculous sinus appears behind

Palpation, the first point to determine is whether the swelling is passing into the scrotum from the inguinal region e g hernia or varicocele or whether it is confined to the scrotum In the latter case the consistency is determined and if cystic the swelling is caused by a spermatocele (including a cyst of the epididymis) vaginal hydrocele or a recent hæmatocele the two former conditions being trans illuminable If the swelling is solid and arises in the epididymis the probable cause is tuberculosis if the body of the testicle is affected a gumma or neoplasm is suspected (Fig 5) while if both the epididymis and body are enlarged the condition is due to epididymo-orchitis A hæmatocele sometimes occurs insidiously

and when partially clotted closely simulates a neo plasm, and is often only to be distinguished on ex ploration



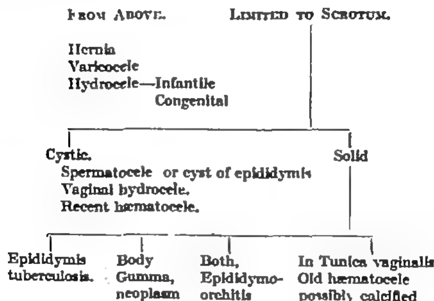
FIG 5 —Teratoma of the left testicle On in pection enlarged veins are obvious. Palpation revealed an irregular solid swelling limited to the scrotum The patient succumbed with pulmonary metastases

Spermatic Cords should then be palpated and occasionally in cases of tuberculosis "beading" of the vas deferens may be detected due to submucous tubercles in that structure If the testicular swelling is due to a neoplasm secondary deposits sometimes occur in the lymphatics of the cord and in any case, the thickness of the cord is usually increased by hypertrophy of vessels and cremaster muscle

General Examination of the patient may reveal other signs of tuberculosis particularly in the prostate, or syphilitic stigmata may be evident e.g in the mouth or "tissue paper" scars over the shins If

malignancy is suspected the lymphatic glands at the level of the first lumbar vertebra are often palpable Epididymo-orchitis suggests infection of some other part of the genito-urinary tract, e g urethritis or cystitis

The following scheme comprises a summary of scrotal swellings



CHAPTER II

ANTISEPSIS AND ASEPSIS

Antisepsis

The *antiseptic* method of treating wounds aims at the destruction of organisms or the prevention of their development in the wound by the use of antiseptics. Antiseptics are either external, which are applied locally, or internal, which are absorbed in the blood, and are thus carried to the area of infection.

External antiseptics are employed in order to destroy organisms or prevent their development in a wound or infected cavity. Since the days of Lister's carbolic acid spray, a constant search has progressed in order to discover antiseptics which are lethal to organisms and at the same time relatively harmless to the tissues.

The external antiseptics in common use include the following:

Alcohol.—Seventy per cent. solution is useful for rinsing the hands after "scrubbing up," whilst 90 per cent. solution containing 2 per cent. iodine is extensively used for preparing the patient's skin.

Carbolic Acid.—A solution of 1 in 20 is a very strong antiseptic and may be used for cleaning the patient's skin, and storing ligatures and drainage tubes after sterilisation. 1 in 60 solution is useful as a hand lotion for the surgeon during operations, for compresses, mouth washes and gargles. *Carbolic acid compresses must never be applied to fingers or toes.* It causes vaso-spasm and gangrene can occur quite painlessly in a few hours.

Mercuric Perchloride.—This is now but seldom

used, as it is irritating to the skin, and corrodes instruments

Mercuric Biniodide—This is used in strengths of 1 in 500 in spirit for the hands and patient's skin or 1 in 4,000 aqueous solution for bladder irrigation

Iodine is an excellent antiseptic and is most commonly employed in the preparation of the skin as a 2 per cent solution in rectified spirit The skin must be dry and non greasy a condition which can be produced by the application of ether Tincture of iodine is also used in the strength of 1 drachm to the pint for irrigating infected cavities and for douching the uterus and vagina

Iodoform.—This was formerly used in the treatment of grossly contaminated conditions and tuberculous lesions

It is contained in B I P paste which consists of 1 part of bismuth 2 of iodoform and sufficient paraffin to make a thin paste This has been extensively used in the treatment of wounds which are carefully dried and then wiped over with the paste, no excess being left in the wound By these means, healing by first intention is obtained in a certain number of infected wounds N.B —B I P is opaque to X rays

Occasionally an excess of iodoform or B I P is absorbed and produces very variable symptoms and signs, including vomiting and diarrhœa, skin rashes pigmentation of the gums headache rapid pulse, mental depression, etc.

Whitehead's varnish which is sometimes used after operations in the mouth, contains iodoform and Tinct Benzoini Co

Lysol is a coal tar derivative and is also a much used antiseptic in the preparation of knives and needles, which should be immersed in undiluted lysol.

Oxyl is a somewhat similar preparation, and is preferable to lysol in that it is less toxic, and is a more powerful antiseptic.

staphylococcus and streptococcus, including streptococcus fæcalis

Systemic administration is either intravenous or *intramuscular* *Continuous intravenous administration* of penicillin in saline maintains a constant blood level, but thrombosis is a common complication *Intramuscular administration is either continuous or intermittent*, in the latter case three or four hourly injections are necessary Penicillin can be administered intramuscularly in the form of oil wax suspension which retards the rate of absorption In the treatment of meningitis 50 000 units of penicillin are injected intrathecally or intracisternally twice daily in addition to systemic therapy

Local application of penicillin solution is valuable in many conditions Thus, some cases of acute empyema subside if pus is aspirated and penicillin (50 000–100 000 units) injected into the pleural cavity once a day Suppurative arthritis frequently responds to similar treatment *Irrigation with penicillin* solution is merely wasteful as penicillin must remain in actual contact with infecting organisms to be effective *Penicillin cream contains 250 units of penicillin* per gramme It is useful in the treatment of superficial burns and wounds

Penicillin can be combined with sterile sulphathiazole powder which is used prophylactically or applied to infected surfaces by means of an insufflator

Penicillin lozenges are useful in the treatment of such conditions as stomatitis and tonsillitis Each lozenge contains 500 units They are stored in screw cap bottles as penicillin rapidly deteriorates in the presence of moisture

Asepsis

The *aseptic* method consists in the prevention as far as possible of the entry of organisms into the wound their elimination being secured by dry or moist heat

This is ideal, but the surgeon's and assistants' hands and the patient's skin cannot be sterilised by heat, therefore, although asepsis is employed in the main, antisepsis must be combined with it

Organisms may be conveyed to the wound by the air of the operating room, the surgeon and his assistants, the instruments swabs, towels, bowls trays sutures, ligatures lotions, water, etc., and each of these must be carefully considered if the wound is to be aseptic

1 The Air of the Operating Room

This should be as free from dust as possible In some hospitals there is a special system for purifying the air as for example by passing it through water to wash it and then filtering it through asbestos wool The operating theatre is treated with superheated steam before operation Visitors in the theatre should wear clean goloshes, sterile gowns, caps and masks, and should not be permitted to enter or leave during the operation

When an operation is in a private house a room with a good light should be selected, preferably on the same floor as the patient Carpets, rugs, and all small furniture are removed If time permits the floor is scrubbed and ledges etc., are damp-dusted with 1 in 80 carbolic acid Attention is paid to adequate light and heat, but no fire or flame is permissible if ether is to be used If no operating table is available two narrow tables are placed together in the form of a T Small tables hot and cold sterile water a hypodermic syringe, and hot water bottles should be in readiness

2 The Surgeon and Assistants

The Hands.—Nails must be kept short and the surgeon should not operate if he has any wound on his hand or forearms He should be particularly careful to avoid touching any wounds or dirty dressings or doing any rectal or vaginal examinations with un

covered hands There are many methods of preparing for an operation but the following is satisfactory The hands and forearms, up to and including the elbows, are thoroughly scrubbed with a sterilised nail brush, soap, and hot water for five minutes, special attention being given to the nails and interdigital spaces They are then rinsed in running water and well rubbed with a swab which is moistened with 70 per cent alcohol Rubber gloves are then put on care being taken not to touch the outsides with bare fingers Gloves can be sterilised by dry heat or boiling In the latter case the gloves should be put in a perforated metal box, to prevent their floating, and boiled for fifteen minutes in water containing no soda

One great danger is wearing a glove which has been pricked In this case sweat containing many bacteria will escape through the hole into the wound Therefore, if a glove is pricked it should be changed immediately

After operation gloves are washed tested for holes, dried and dusted with French chalk.

The Hair—Sterilised caps are worn to prevent epithelial débris from dropping into the wound

The Breath.—Sterilised masks made of four thicknesses of gauze are worn over the mouth and nostrils to filter the breath Sometimes a layer of cellophane is incorporated between the layers of gauze But even though they are worn talking should be of a minimum amount and unavoidable coughing and sneezing directed away from the wound There must be no septic foci in the mouth and nose and those in close proximity to the operation should be free from cold or recent influenza

II THE SKIN OF THE PATIENT

The simplest and possibly the best way of preparing this is as follows The operation site is shaved, and then cleaned and dried with ether In some cases it is

necessary to wash the skin thoroughly before applying the ether Special attention must be given to depressions such as the umbilicus and folds of skin causing intertrigo

A 2 per cent solution of iodine in rectified spirit is then freely applied, and the whole covered with a sterile towel which is bandaged in position Immediately before the operation the site is again painted with the iodine solution The prepared area of skin should always extend well beyond the proposed field of operation

By some surgeons, 3 to 5 per cent picric acid in spirit is preferred to iodine, but susceptible patients develop a severe local, or even general, skin rash Metaphen, although expensive, is an excellent preparation—probably the best

In an emergency the skin may be prepared by dry shaving the part, applying ether and then iodine solution, no attempt at cleaning being made After the iodine has dried another application is made and the operation performed The skin must be dry and non-greasy when iodine is applied, otherwise its power of penetration is greatly lessened

4 Mackintoshes

Mackintoshes are best prepared by thoroughly scrubbing with 1 in 40 carbolic lotion, and after use, are always covered with sterile towels or sheets

5 Towels, Gowns, Swabs, Dressings, Abdominal Pads

These are placed in tins of which the lids are left open, and sterilised in a suitable autoclave or steriliser Steam, under pressure, is the usual method The boxes are then sealed until required for use

In emergency, towels can be prepared by soaking in 1 in 20 carbolic lotion for half an hour, and wringing out in 1 in 60 lotion when required for use Swabs are

made of cotton wool contained in a layer of gauze, or may consist of gauze alone. Dressings and abdominal pads are usually made of gauze. If considerable oozing is to be expected, as after radical amputation of the breast, gamgee pads are valuable.

6. Bowls, Nail-brushes, Trays, etc.

These should be boiled for 10 to 15 minutes, but if this be impossible a little methylated spirit may be burnt in the bowls and trays, and boiling lysol solution then poured into them.

7. Instruments

Instruments are sterilised by boiling for 15 minutes in water containing sodium bicarbonate (ʒi to Oi). This raises the boiling point, prevents rusting and removes grease.

Most sterilisers are fitted with a tray in which the instruments are removed, but if this be absent, they should be lifted out with a pair of sterile forceps, Spencer Wells's, and all forceps that clip should be opened before being put into the steriliser.

Drainage tubes are sterilised by boiling and stored in 1 in 20 carbolic acid lotion.

Knives and Needles are blunted by boiling, but can be sterilised conveniently by immersion in 15 to 20 per cent. lysol or oxyl solution in rectified spirit for 24 hours, and when required for use, rinsed in 1 in 60 carbolic acid solution.

When an instrument is urgently wanted it can be sterilised rapidly by immersion in pure carbolic acid for half a minute and washing off the excess in sterile lotion.

After operation instruments are well scrubbed in hot water, special care being given to joints and serrations. They are then resterilised, rinsed in sterile water, wiped with methylated spirit and thoroughly dried.

Ligatures and Sutures.—Silk, silkworm-gut, horse hair, nylon, linen thread, catgut, and kangaroo tendon are the most generally used ligature and suture materials

They are prepared as follows

Silk is sterilised by winding loosely on reels or rubber tubing and boiling for one hour It is then stored in absolute alcohol Before use, it should be washed in sterilised water It is sold in hanks of fifteen yards, and the most useful sizes are 00 000 0000

Floss silk, commonly used for hernia operations, is similarly sterilised *Silk and thread should not be wound on glass slides and then boiled, as is commonly done* Expansion of the glass stretches the material and a sharp edge is apt to fray it Rubber tubing or spools are quite suitable

Silkworm gut is sterilised by boiling for half an hour It is kept in 1 in 20 carbolic acid lotion, but should be transferred to 1 in 60 when required for use It is prepared in five sizes thick, medium, fine very fine, extra fine

Horse hair is prepared in the same way as silkworm gut

Linen thread is prepared in the same way as silk

Catgut may be sterilised in several ways, of which the iodine method is the usual

Catgut, wound loosely on a glass winder is immersed in the following solution for 8 days

Iodine	1 part
Pot. Iodide	2 parts
Distilled Water	87
Methylated Spirit	60 „

It is then ready for use and can be stored in a half strength solution of the above or in alcohol Most surgeons use sterilised catgut in sealed tubes which are themselves sterilised by immersion in methylated

spirit Catgut is procurable in twelve sizes, six 0 to 6 The finest is useful for ophthalmic work

Kangaroo-tendon is prepared by the same methods as is catgut

Of the ligature and suture materials described catgut alone is absorbable and is commonly used for ligatures and buried sutures It is also employed for circumcision and the suturing of mucous membranes

Horse hair is a convenient suture for wounds on the face and neck, where a scar should be as invisible as possible Owing to the fact that silkworm gut and nylon are now made in extra fine sizes they have to some extent replaced horse hair

Linen thread is useful for purse-string sutures required to bury the stump of the appendix, or to close a perforated ulcer of the stomach Many surgeons use it for intestinal anastamoses, and for ligatures in clean operations, notably removal of the breast and subtotal thyroidectomy

Kangaroo tendon is employed for ligating large vessels, such as the innominate artery whilst it is also very convenient for stitching fasciae and apposing small bony fragments Its use in hernia operations has been superseded by floss silk or a fascial graft.

CHAPTER III

PREPARATION OF A PATIENT FOR OPERATION—THE OPERATION—AFTER-TREATMENT

Preparation of a Patient for Operation

In all but emergency cases, it is advisable for the patient to be in hospital or nursing home for at least 24 to 48 hours beforehand On admission the patient should have a hot bath, or, if this be contraindicated, a blanket bath by the nurse The mouth should be cleansed carious teeth should have been extracted or filled in order to diminish the risk of aspiration pneumonia and parotitis In patients suffering from oral conditions such as carcinoma of the tongue it is well to accustom them to taking food through a feeder with a long delivery tube Similarly some degree of post-operative anxiety or even retention is avoided if a male patient accustoms himself to the use of a urine bottle while recumbent The diet for two days before operation should be light and easily digested, and the stomach should be empty at operation To ensure this the last meal is given about 5 hours before the anæsthetic, but a cup of tea glucose or bovril is allowed 2 to 3 hours beforehand

As it is desirable to have the bowels empty a mild and accustomed aperient is taken on the previous day Purgings and enemata (except in rectal cases) are to be avoided as distension and discomfort are thereby encouraged

In cases of intestinal or pyloric obstruction, or gastric distension from other causes the stomach should be

washed out just before the anæsthetic is administered, and a Ryle's tube left in position The bladder should always be emptied, a catheter being passed if necessary It is usually advisable to avoid operating during the menstrual period, especially for pelvic conditions, as pelvic congestion is thereby increased

For operations on the rectum, and anal canal, and vagina, it is essential to have the bowels empty Most surgeons order an enema the night before, and a rectal wash-out on the morning of the operation

Sterilised food and gastric lavage are ordered by some as a preliminary to all operations on the stomach and duodenum whilst others merely advise lavage, if dilatation of the stomach be present

See also Preparation of the Skin (page 28), and Pre anæsthetic Preparation (page 360)

Before the operation is commenced everything should be in readiness This can only be satisfactorily accomplished by good team work. The surgeon assistants, and the sister in charge of instruments will all have prepared themselves, as described in the chapter on asepsis Having received premedication in his own room or been anæsthetised in an adjoining room, the patient is transported either on the operating table or on a trolley, and transferred to the table by the ' dirty ' assistants or dressers, who, not having sterilised their hands and forearms nor put on necessarily sterile gowns, must on no account touch anything within the operation area The operation field is exposed and the skin painted with some suitable antiseptic Sterile towels are then applied and fastened in position by means of towel clips

All instruments likely to be required, having been sterilised are placed either in a sterile tray containing antiseptic lotion or on a sterile towel on a table near the surgeon On this table are also the ligatures and sutures

Swabs and abdominal pads are kept in the tins in which they were sterilised and when required are removed by means of sterile forceps by a "clean" assistant or the house surgeon It is the duty of the "dirty" assistants to open tins of swabs, pads, and dressings as required, but on no account may they touch the inside of a tin, or anything sterile, which is being used in connection with the operation

The position of the patient is generally supine, and in operations on the liver and gall bladder a small sand bag is placed beneath the spine unless the operating table is fitted with an adjustable bridge The *prone* position is required for operations on the back and the vertebral column a small pillow should be placed under the pelvis and another under the upper chest, so as to facilitate respiration

The *left or right lateral position* is very useful for operations in the perineal region and on a kidney The patient lies on his side with the lower arm pulled out behind him and the upper arm supported on an arm rest The knees and hips are well flexed A small pillow is placed under the head for comfort and in operations upon the kidney a bridge is useful so as to widen the ilio-costal space (normally two and a half inches)

Trendelenburg's position is employed for pelvic operations and in it the patient lies flat on the back the pelvis being raised above the head by elevating the foot of the table By these means the intestines and the abdominal viscera gravitate away from the pelvis allowing a less obstructed view of that part

For upper abdominal operations it may be desirable to put the patient in a reversed position to that of Trendelenburg and this is accomplished by tilting the table

For operations on the perineal region the *lithotomy* position may be used and is maintained either by the use of a Clover's crutch, or by adjustable vertical supports, which are fixed to the lower end of the table.

The Operation

The incision should avoid important structures, but at the same time give adequate exposure, whilst on the face and neck and elsewhere especially in women, the incision, where possible, should be made in a natural skin crease Examples of this are Kocher's collar incision for goitre, Ferguson's incision for removal of the superior maxilla and Gaillard Thomas's incision in the thoraco-mammary fold for removal of swellings in the breast (Fig 6) Generally speaking it should be parallel to and not across, the large vessels and nerves of the part The skin is divided cleanly with a sharp knife and the deep fascia exposed by incising the subcutaneous tissues When the deep fascia has been divided any muscles exposed should be retracted or their fibres separated In the gridiron incision for appendicectomy the external and internal oblique and transversalis muscles are split in the line of their fibres whilst in the paramedian incision after the anterior rectus sheath has been freely incised vertically the rectus muscle is retracted outwards and the posterior sheath incised in the same line as was the anterior layer Sometimes it is necessary to divide a muscle across the line of its fibres, and generally no harm results provided that the muscle is carefully sutured Nerves, especially motor, should be avoided or paralysis of the muscles supplied will

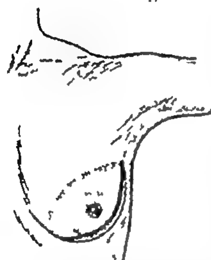


Fig 6 —Gaillard Thomas's incision. The dotted area indicates deep surface of the breast which can be readily exposed

result, and in the abdomen an incisional or inguinal hernia may subsequently develop It being impossible to sterilise the skin, this should be excluded from the field of operation by gauze pads clipped to the edges of the skin wound by Moynihan's forceps During the operation, hæmorrhage is arrested by the application of hæmostatic forceps Small arteries may be occluded by torsion the forceps being given five or six half turns—on no account should they be completely twisted off Larger arteries require ligation with catgut thread or other suitable material General oozing is checked by saline irrigation at 120° F or by pressure and parenchymatous oozing by the cautery or diathermy Deep structures such as the peritoneum muscles, and aponeuroses should be closed layer by layer continuous catgut sutures being the most generally used The deep fascia should be stitched separately, or else included in the skin stitch, otherwise a broad ugly scar will ultimately result In operations on the neck careful co-aption of the platysma is obtained by fine catgut sutures In other situations subcutaneous fat must be approximated, either by sutures which include the deep fascia or by inclusion in the skin sutures otherwise a "dead space" results in which serum and blood collect The resulting hæmatoma is liable to become infected

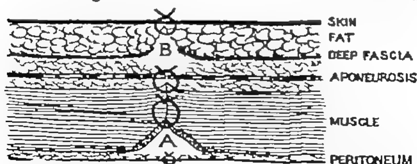


FIG 7.—Common errors in closing an appendix incision. A and B indicate "dead spaces" in which serum can accumulate owing to inefficient suture of muscle and subcutaneous fat with consequent risk of infection.

The Operation

The incision should avoid important structures but at the same time give adequate exposure, whilst on the face and neck and elsewhere especially in women the incision where possible should be made in a natural skin crease. Examples of this are Kocher's collar incision for goitre, Ferguson's incision for removal of the superior maxilla and Gaillard Thomas's incision in the thoraco-mammary fold for removal of swellings in the breast (Fig. 6). Generally speaking it should be parallel to and not across the large vessels and nerves of the part. The skin is divided cleanly with a sharp knife and the deep fascia exposed by incising the subcutaneous tissues. When the deep fascia has been divided any muscles exposed should be retracted or their fibres separated. In the gridiron incision for appendicectomy the external and internal oblique and transversalis muscles are split in the line of their fibres, whilst in the paramedian incision after the anterior rectus sheath has been freely incised vertically the rectus muscle is retracted outwards and the posterior sheath incised in the same line as was the anterior layer. Sometimes it is necessary to divide a muscle across the line of its fibres, and generally no harm results provided that the muscle is carefully sutured. Nerves, especially motor, should be avoided or paralysis of the muscles supplied will



Fig. 6.—Gaillard Thomas incision. The dotted area indicates deep surface of the breast which can be readily exposed.

result, and in the abdomen an incisional or inguinal hernia may subsequently develop. It being impossible to sterilise the skin, this should be excluded from the field of operation by gauze pads, clipped to the edges of the skin wound by Moynihan's forceps. During the operation, hæmorrhage is arrested by the application of hæmostatic forceps. Small arteries may be occluded by torsion, the forceps being given five or six half turns—on no account should they be completely twisted off. Larger arteries require ligation with catgut thread, or other suitable material. General oozing is checked by saline irrigation at 120° F. or by pressure, and parenchymatous oozing by the cautery or diathermy. Deep structures such as the peritoneum, muscles, and aponeuroses should be closed layer by layer, continuous catgut sutures being the most generally used. The deep fascia should be stitched separately, or else included in the skin stitch, otherwise a broad ugly scar will ultimately result. In operations on the neck careful co-aption of the platysma is obtained by fine catgut sutures. In other situations subcutaneous fat must be approximated, either by sutures which include the deep fascia, or by inclusion in the skin sutures, otherwise a "dead space" results in which serum and blood collect. The resulting hæmatoma is liable to become infected.

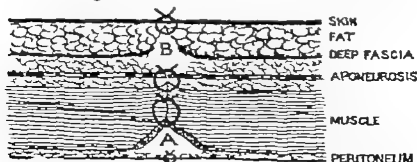


FIG. 7.—Common errors in closing an appendix incision. A and B indicate "dead spaces" in which serum can accumulate owing to inefficient suture of muscle and subcutaneous fat, with consequent risk of infection.

suture The two ends are fastened by collodion or tied to a small roll of gauze On the fifth day one end is cut short the other unfastened and pulled upon the suture thus being removed If catgut is used removal is unnecessary Fig 13

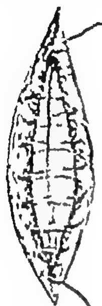


Fig 13.—Subcuticular suture

5 *Lembert's suture* is best described by a diagram (Fig 14) and is extremely *valuable in gastro-intestinal work* as it apposes peritoneal surfaces

6 *The come back suture* (Fig 15) is useful in order to approximate subcutaneous fat and skin with a single suture so as to avoid the presence of a dead space in which liquefied fat and serum may accumulate

7 *Purse string suture* is a continuous Lembert suture and is particularly useful for burying the stump of the appendix or a perforation of the stomach or intestine

8 *Michel's clips* are used by some surgeons for closing the skin incision but they do not approximate the deep fascia They consist of metal bands with a little spike at each end and are inserted and removed with special forceps

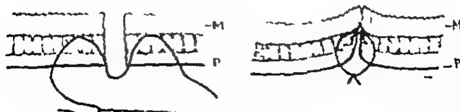


Fig 14 —Lembert's suture introduced and tied M = mucosa, P = peritoneum

necessary, the tube is removed when no longer required, usually 24 to 48 hours, the wound painted with a suitable antiseptic, and a sterile dressing applied, the further treatment being as just described

Should a patient, who has an abdominal incision be suffering from a cough the stitches may be retained for 10 to 12 days For the dressing of an infected wound, the same accuracy of detail with regard to asepsis is necessary Dressing will be required daily or even more frequently

In the case of an operation for a deep abscess or ischio rectal fistula, in which the wound has been packed with gauze, redressing will not be necessary for 24 to 48 hours when it may be advisable to give the patient gas or evipan on account of pain caused by the dressing

Bursting of an Abdominal Wound.—This may occur either before or after removal of the stitches It is predisposed to by cough infection, and abdominal distension combined with inefficient suturing especially of peritoneum as omentum insinuates itself through the resulting gap A general anæsthetic is given the exposed coils of gut being covered meanwhile with a sterile towel The coils are bathed with sterile saline, replaced and the wound closed, if possible, in layers If this is difficult stout silkworm sutures are inserted through all layers of the abdominal wall, at intervals of half an inch They are tied in succession when all have been inserted These cases usually do surprisingly well.

Strapping a Wound.—When a wound tends to gape a sterile dressing is applied and a piece of strapping fixed to the skin on one side, after which it is pulled upon and fixed to the skin on the other side A very useful method of approximating a gaping wound is the hare lip application of strapping (Fig 16) Two pieces of adhesive plaster are cut as depicted A and D are applied on either side of the

tied over the gauze dressing, which is thus held in position

If an aseptic wound becomes infected the infection usually manifests itself by a throbbing pain in the wound and a rise of temperature after 36 hours It must be remembered that during the first 24 to 36 hours, the temperature may be raised about 1 degree as a result of aseptic traumatic fever—but after that period, it should suggest infection and an examination of the wound is necessary If infection has supervened, the edges of the wound appear red and swollen, whilst pus may be visible in the line of the wound or at the suture holes A stitch or stitches are removed to relieve tension and allow the escape of pus This may be all that is necessary, in which case a sterile dressing should be applied and changed sufficiently frequently In more severe cases hydrogen peroxide (10 vol) may be used to irrigate the wound, and if considered advisable, drainage by a rubber tube glove drain or moist strip of gauze employed Sometimes additional incisions are required for collections of pus not draining freely through the original wound whilst if cellulitis develops, fomentations may be used with advantage or hot saline baths if the wound is situated on an extremity Chemotherapy or the administration of penicillin may be advisable When acute inflammation has subsided, the application of ichthyol (10 per cent) in glycerine is one of the best preparations to promote healing by granulation

(B) **Of the Patient.**—He is taken back to bed and kept warm—see after treatment of an anæsthetic When recovered from the anæsthetic, he will be placed in the position necessitated by the condition for which operation was performed e.g in a Fowler's bed (or some improvisation) following an operation in which peritonitis might develop Elderly patients, and those with a tendency to respiratory affections, will be propped up as early as possible.

After severe operations patients are apt to suffer from **shock**, which manifests itself clinically by the following signs

The patient is conscious pale or livid (which is a combination of pallor and cyanosis), cold and clammy The pulse is feeble, of low tension, may be slow but is usually rapid The respiration is shallow, the temperature subnormal the musculature relaxed but the reflexes are present and the pupils equal and react though somewhat sluggishly, to light and accommodation There is diminution in the amount of urine passed, sometimes amounting to total suppression Both faeces and urine may be passed involuntarily

Fall of blood pressure is the most important clinical sign and can be used for measuring the degree of shock Absence of restlessness helps to distinguish shock from haemorrhage

Shock is either primary or secondary

Primary shock is associated with fear and pain Those who are injured while their minds are engrossed such as soldiers in the heat of battle, are unlikely to suffer from primary shock even though seriously wounded On the other hand, nervous persons are often severely shocked although their wounds are trivial Painful wounds such as widespread superficial burns are apt to be associated with severe shock, even in phlegmatic persons.

Secondary shock occurs within two to a few hours after the injury It is predisposed to by cold exposure starvation loss of body fluids including blood absorption of products from damaged tissues, and toxaemia

Prophylactic Treatment of Shock in Operations.—*Fear* on the patient s part is minimised by encouragement and premedication He should be kept *warm* by suitable clothing hot water bottles, or pillows, and the temperature of the operating room should be about 70° to 75° Prolonged *starvation* before

operation is harmful and should be avoided, especially in children and old people If the patient has suffered any severe *loss of blood or tissue fluids* by diarrhœa and vomiting, preliminary saline infusions, plasma, or blood transfusion will be helpful

Blocking of the paths along which the nociceptive impulses pass can be accomplished by injecting the main nerve trunks with 2 per cent novocaine, or using spinal analgesia Even when nerve blocking is em ployed, all operative manipulations must be per formed as gently as possible pulling on structures avoided, and incisions never replaced by forcible stretching or tearing

Resuscitative Treatment of Shock.—This consists in absolute quiet in bed the foot of which is raised to maintain the cerebral circulation The patient should be kept warm with blankets and hot water bottles (outside the blankets), but the temperature of the bed should not exceed 100° Electrically warmed blankets are very useful, provided that exces sive heat is not generated

When the fall of blood pressure is very great, the extremities may be bandaged from the periphery to the trunk. With very few exceptions stimulants should not be given but intravenous eucortine seems to be of value in some cases Saline infusion serum or plasma is sometimes required (page 157) Blood transfusion should be reserved for those cases of shock in which the patient is exsanguinated

Pain is relieved by a suitable dose of omnopon (gr ½ for an adult) which is adequate in all but really severe cases, and is much superior to morphia, in that it does not derange the alimentary tract or cause mental depression In some patients nausea, distension vomiting and constipation are encouraged by even a single dose of morphia and many an anæsthetist is wrongly blamed for post anæsthetic vomiting which is actually caused by morphia If the narcotic effect

of omnopon is required without delay, half the usual dose should be injected intravenously. Pain persisting for more than 24 hours after an abdominal operation should be suspected as due to some other cause rather than merely "post-operative." Pain in the legs is sometimes relieved by raising them or placing a pillow beneath the knees, whilst if it results from pressure of the bed-clothes on a wound, the latter should be protected by a suitably arranged cradle. Oxygen inhalation, formerly popular, is now known to be of no benefit.

Thirst is controlled by giving the patient plenty of water to drink compatible with the nature of the operation. Rectal salines or tap water (which is absorbed much more rapidly than saline), are valuable as an adjuvant, or if swallowing is contraindicated.

Insomnia is treated by relieving the pain causing it. In those cases in which it is present in the absence of severe pain, allonal, or grs. 30 of potassium bromide (for an adult) given about ½ to ¾ of an hour before sleep is required, is usually successful.

Retention of Urine not infrequently occurs and is especially prone to follow operations on the rectum, perineum, vagina and pelvis, hernia and varicocele. It is very important for the house surgeon to remember this and make sure that the bladder has been emptied after operation. In the case of pelvic operations, e.g. hysterectomy, neglect in this respect may cause the peritoneal suture in the floor of the pelvis to give way. A catheter should be avoided if possible. Hot sponges are applied to the hypogastrium and perineum if the position of the wound allows this and changing the patient's position, e.g. from on the back to the side. A few words of encouragement sometimes work like a charm. An injection of Moryl or Esmodil (choline preparations) causes vesical contraction and is frequently successful, but these preparations are contraindicated following operations on the abdomen

tory tract, as peristalsis is also stimulated. When these methods fail, a sterile soft rubber catheter is required.

Vomiting after an anæsthetic usually ceases without any special treatment. It is aggravated if the stomach was not empty at the commencement of the anæsthetic, and is sometimes brought on by unnecessary jolting during the moving of the patient from the table to the bed. Subsequent to operations on the mouth, nose, and throat it may result from the swallowing of blood. If it persists for more than a few hours, the patient should be given a drink of half a pint of warm water, containing half a drachm of sodium bicarbonate. This is usually returned in a few minutes, and at the same time washes out the stomach.

Hot coffee, champagne and tincture of iodine (♏ii) in water and a mustard leaf on the epigastrium are sometimes successful. More severe cases, especially if the vomit contains much bile, necessitate washing out of the stomach. The old fashioned stomach tube is only required in cases of poisoning when the stomach may contain solid food. For gastric lavage a Ryle's small tube causes very little discomfort and can be left in position as long as necessary. After 10 per cent cocaine has been applied by means of a spray, the tube is passed either through the nose or mouth. As the tube enters the pharynx sips of water help its passage on into the stomach. The patient can then drink and the stomach is emptied and cleansed by aspiration with a large syringe. The tube is fixed to the cheek with strapping and aspiration or lavage adopted as necessary. The fact that the patient can drink adds to his comfort, even if the fluid is immediately aspirated.

Acute Dilatation of the stomach can follow any operation or even a severe injury, and is characterised by intense thirst, huge vomits, a visible and palpable distension of the stomach, and shock and collapse.

gland, which is swollen (Fig 17) Pain is severe owing to the close investment of the unyielding fascia which envelops the gland As soon as œdema appears an incision must be made parallel to the facial nerve, and the gland explored with sinus forceps It is a mistake to await fluctuation as this will only occur when pus has eroded the enveloping fascia by which time extensive necrosis of the gland may have occurred If untreated, pus commonly escapes through the external auditory meatus. Many threatening cases can be aborted by attention to the mouth lemon drinks and the application of antiphlogistine Chewing gum is also useful

Ileus Paralyticus is treated by different surgeons in different ways Some advise "masterly inactivity" with at the most the use of the rectal tube or occasional enema Others advise active measures, which have been described as the "vowel" treatment of the bowel (Harold Dodd) It comprises Aperients Enemata Injections such as eserine and pituitrin, Operation (enterostomy or entero-enterostomy), Undertaker

Thrombosis and Embolism —Thrombosis generally follows operations on the lower abdomen and usually affects the iliac and femoral veins, most commonly on the left side as the left common iliac vein passes under, and is therefore somewhat compressed by the right common iliac artery The average interval between the operation and onset of thrombosis is ten days A slight asymptomatic rise of temperature warns a thoughtful clinician that thrombosis is impending This is followed by pain in the leg and after a few days swelling and œdema are pronounced

Treatment is both symptomatic and directed towards the prevention of pulmonary embolism The leg should be slightly raised on a pillow and immobilised between sand bags for about 4 weeks

Although this period is not always necessary, it is a safe minimum

When thrombosis affects a more peripheral vein and rapidly spreads proximally or suppuration occurs the vein should be ligated proximally

At a later date, periodic elevation and crêpe bandages applied from the foot upwards will be necessary in those cases in which swelling of the extremity persists Varicose veins may develop subsequently They are then forming a collateral circulation, and injection is contraindicated

Pulmonary Embolism may occur, and is predisposed to by dehydration of tissues following vomiting or loss of blood and is particularly likely to follow operations in the pelvis especially if infection follows These three factors are all associated with prostatectomy, which operation accounts for 17 per cent of post-operative emboli In its most tragic form a single large embolus becomes lodged in the pulmonary artery causing the patient to start up suddenly in bed and gasp A hurried request is sometimes made for a bed pan and death usually follows after a few seconds or minutes' urgent distress If time permits morphia and oxygen are administered Embolectomy has been attempted and this 'resurrection' operation is occasionally successful

In the milder form smaller emboli are arrested in the pulmonary arterioles and cause pain and hæmoptysis A stethoscope usually detects a pleural rub and fine crepitations Although recurrence often occurs the ultimate prognosis is good Some local application, e g antiphlogistine, is useful to relieve pain, and mild expectorants are given

Pulmonary Complications —These are (i) bronchitis, (ii) aspiration broncho pneumonia (iii) lobar pneumonia, and (iv) hypostatic pneumonia (v) massive collapse of the lung

The first is the commonest and usually results from

the administration of cold ether vapour, or "catching cold" during transit from the ward to the operating theatre. The second results from inhalation of vomit, septic material, or blood-clot from the mouth and pharynx The third is rare and is a typical lobar pneumonia resulting from the same causes as did (1)

The fourth is really a passive congestion due to impairment of the circulation of the bases of the lungs resulting from cardiac insufficiency, and inadequate basal expansion due to diminished diaphragmatic action as a result of upper abdominal operations and *abdominal distension or prolonged confinement* to bed in old people, e g following fracture of the neck of the femur It is predisposed to by excessive in fusion of saline

Massive collapse of the lung sometimes known as active lobar collapse in order to distinguish it from passive collapse, is due to obstruction of a bronchus by a plug of mucus It may follow any general anæsthetic and is most common in children and young adults The heart is displaced towards the affected lung and a radiograph will show opacity of the affected area Constriction of the lower chest by tight bandages and premedication by morphia and atropine predispose to the condition

Immediately the condition is recognised the method advocated by Sante should be practised The patient is laid flat in the dorsal position and gently rolled a dozen or so times from one side to the other This usually results in expectoration of the obstructing mucus, with immediate relief of symptoms If the first manipulation is unsuccessful, the process should be repeated every four hours Bronchoscopic aspira tion is used as a last resort Inhalation of carbon dioxide is contraindicated as the resulting hyper pnœa merely aspirates the plug farther down the bronchus

CHAPTER IV

WOUNDS

GENERAL CONSIDERATIONS—THORAX — ABDOMEN — HEAD —HÆMATOMATA OF SCALP AND EAR— BLACK EYE "— BURNS—BITES—FOREIGN BODIES—SPORTS INJURIES

WHEN the wound is an aseptic one made by the surgeon healing by first intention should occur This is brought about by a careful arrest of hæmorrhage accurate suturing the application of an antiseptic, and applying an aseptic dressing If the depths of the wound cannot be obliterated by the pressure of a bandage, e g operations on scrotal contents, then drainage is provided

If the wound is accidental infection may occur

First-aid Treatment should consist in the arrest of hæmorrhage (see chapter on Hæmorrhage) the removal of any obvious dirt or foreign bodies from the wound and covering the latter with any improvised and suitable dressing e.g a clean handkerchief

Surgical Treatment.—A careful examination should be made with all aseptic precautions to determine the extent of the injury As the diagnosis of a nerve lesion will depend on loss of movement and sensation, it is obvious that it must be arrived at before an anæsthetic is administered Attempts to perform active movements will usually determine the presence of divided tendons

The skin around the wound is now painted with 2 per cent iodine in rectified spirit, but if this is unobtainable or the skin is very dirty the wound is packed with sterile gauze dipped in an antiseptic

such as 1 in 500 flavine solution, and the surrounding skin washed, shaved, dried, and defatted with ether, and then washed with some suitable antiseptic Sterile towels should be placed round the wound and the gauze packing removed The importance of maintaining careful asepsis and antisepsis cannot be emphasised too strongly Crushed and damaged tissues should be excised foreign bodies removed vessels ligated, nerves and tendons sutured, and, especially in head injuries, careful examination made for fracture of underlying bone

The next point to decide is the advisability of closing the wound If it has been possible early to clean up the wound within a few hours of infliction, i e before infection is established, and if marked crushing of the tissues is absent, the wound should be insufflated with sulphathiazole powder (grs v to grs xv) and sutured A drain is inserted for 24 to 48 hours if oozing is expected

Interrupted sutures will be used so that if infection occurs one or two can be removed as required If the wound be near a joint the latter should be immobilised by a plaster cast, if a nerve or tendon has been sutured, neighbouring joints may be suitably flexed or extended on splints to relax the sutured structures

When primary suture of the wound is impossible, it should be insufflated with sulphathiazole powder, packed with vaselined gauze and immobilised as by encasing it in plaster of Paris If considered necessary a prophylactic course of chemotherapy is prescribed As in all cases where tetanus *may* develop a suitable dose of antitetanic serum *must* be administered Prophylactic administration of penicillin is a valuable adjuvant in the prevention of infection

The question of amputation demands careful consideration Surgery should be conservative within reason, and it may be difficult to choose the correct

course between extreme conservatism on the one hand and impetuous radicalism on the other In the former case after many weary months of treatment, the patient may be left with a member which is quite useless or even a grave nuisance, so that amputation becomes essential, whilst in the latter case a patient may lose a part which skill and care could have saved

The Indications for Amputation after Accidents are

1 When it is necessary to rescue a person from machinery or débris other methods having failed

2 When infection e.g gas gangrene spreads in spite of treatment

3 When the limb has been so severely damaged that in the surgeon s opinion, it will be useless if saved The injury may affect nerves muscles bones joints or vessels or any combination of these structures

4 When gangrene is present or inevitable

The following points should also be borne in mind

1 Amputations of the lower extremity are economically less serious than those of the upper extremity

2 Amputation in an elderly patient should be performed earlier than in the young and their recuperative power is impaired

3 In the case of the arm length and mobility are important while in the leg stability and sound weight bearing surface are of more value

Infected Wounds—When treating infected wounds it is necessary to remove foreign bodies provide adequate drainage and apply moist aseptic dressings which are changed frequently Sometimes it is necessary to irrigate the wound Rest and the general constitutional treatment of infection must not be omitted

In small infected wounds often the only treatment required is hypertonic saline or antiseptic baths or boric acid fomentations In a large suppurating wound with inadequate drainage a general anæsthetic should be given, foreign bodies removed a free and

dependent opening made for the escape of discharges, and any relatively unimportant tissue, likely to obstruct this removed A rubber drainage-tube or tubes with or without gauze wicks will be inserted, according to the depth of the wound, care being taken to avoid their proximity to important blood vessels

Irrigation with weak antiseptics such as hydrogen peroxide 5 to 10 volumes, sterile saline, or eusol is useful from time to time to wash away any retained exudate and sloughs Eusol must be freshly prepared, and not warmed to a temperature higher than 100° F, otherwise its active principle, chlorine, will be driven off Due consideration is given to the advantages to be gained by the administration of sulphonamide preparations and penicillin

Wounds of the Thorax

Non-penetrating—Wounds of this type often produce a severe degree of shock. Hæmoptysis, dyspnœa, hæmothorax, pneumothorax, and surgical emphysema may be present

Treatment is to combat shock, and the patient is usually most comfortable when propped up in bed

Sometimes hæmo- and pneumothorax require operative interference (see Fractured Ribs)

Penetrating—If the wound is very small as in a bullet or stab wound the signs and symptoms are similar to those described for non penetrating wounds and the treatment consists in sterilising the small external wound and then treating expectantly as for a non penetrating wound

When the wound is large and gaping, first-aid treatment consists in rapid cleansing of the wound and closing it by means of a copious antiseptic dressing Permanent treatment requires preliminary screening of the thorax, followed by the administration of an anæsthetic After the usual aseptic and antiseptic

preparations excision of the wound is performed This should include crushed and badly damaged skin, subcutis, muscle, loose pieces of or obviously contaminated bone, pleura, or lung Foreign bodies and blood clot, which tend to collect in the costo-phrenic sinus are removed, and bleeding vessels are ligated Sulphanilamide powder is insufflated, and chest wall is sutured as adequately as circumstances permit

When the operation is completed, air is aspirated from the pleural cavity Should an effusion follow, this may be aspirated, but if infection supervenes drainage will be necessary When a penetrating wound involves the lower part of the thorax, the possibility of wounds of the diaphragm, liver, spleen, and kidneys must be remembered

Wounds of the Abdomen

Non-penetrating—These are of importance on account of the possibility of subcutaneous rupture or tear of the liver, spleen kidney stomach mesentery intestines or bladder After the accident the patient may suffer from 'peritonism' which consists of shock abdominal pain and vomiting and it may be impossible to decide whether there is any concomitant visceral rupture Therefore the patient should be put to bed and the pulse rate taken every quarter of an hour If he recovers from the shock, he will often experience a period of relief from symptoms but this transitory period is succeeded by the signs and symptoms of internal hæmorrhage (see Hæmorrhage) if the liver spleen kidney or large blood vessel is ruptured or those of peritonitis if a hollow viscus is perforated

If the viscus concerned is the stomach or intestine free gas will occur in the peritoneal cavity and is alleged to diminish the liver dullness (N B —A distended colon will mimic this sign) An X ray will sometimes disclose a bubble of gas beneath the

diaphragm, and this is a more reliable sign than diminution of liver dullness as demonstrated problematically by percussion The small bowel suffers injury in one of two ways, either by compression against the sacral promontory, or by avulsion at the duodeno jejunal flexure

When the injury involves the lower abdomen, the possibility of a ruptured bladder should be considered A catheter is passed, and according to the amount of urine drawn off and the presence in it of fresh blood the diagnosis of rupture will be made Sterile lotion may be injected into the bladder and a diminished amount returned if the bladder is ruptured

The treatment of a ruptured viscus is immediate operation

Penetrating Wounds.—It is essential to explore thoroughly every penetrating wound of the abdominal wall and carefully examine for a perforation of the peritoneum If the peritoneum is intact the usual treatment of a wound should be carried out but if perforated the opening should be enlarged to allow a complete examination of the abdominal viscera

Wounds of Joints

Penetrating injuries of joints are suspected by the position of the wound or wounds and confirmed by the escape of oily synovial fluid In all cases the limb should be immobilised in its optimum position for usefulness until the infection has subsided, in case ankylosis subsequently develops

A punctured wound of a joint is treated expectantly The penetrating object e g a needle is removed if still present and the puncture is sterilised The limb is immobilised and a prophylactic sulphonamide preparation or penicillin injections are administered

A more extensive wound, such as laceration by a nail or foreign body requires an emergency operation

The wound is excised in layers and partially or completely closed according to circumstances. The limb is then immobilised in the optimum position so that the minimum of disability will ensue in the case of subsequent ankylosis. A prophylactic course of sulphonamide or penicillin is prescribed and if considered advisable, the joint is aspirated once or twice daily, and penicillin (50,000 units) is injected after the fluid is withdrawn.

Wounds of the Head

The main importance of these depends upon concomitant cerebral injury and the tendency for infection to extend inwards and involve intracranial structures.

Concomitant cerebral injury includes concussion, compression and cerebral irritation.

The clinical picture of **concussion** varies from transient dizziness to prolonged unconsciousness and death. Moderate degrees resemble shock (see Post-operative treatment), but the patient may be unconscious, although semi-consciousness, from which he can be temporarily aroused, is the usual condition. The pupils are equal and react sluggishly, and the tension of the pulse is diminished. Concussion is followed by reaction, compression or irritation. If unconsciousness lasts more than 24 hours pneumonia is to be feared.

The onset of *reaction* is evidenced by flushing of the face and vomiting, the patient's condition gradually becoming normal, i.e. the temperature and blood pressure rise, and the breathing becomes deeper. At this stage severe headache is a common symptom.

Treatment of Concussion.—The patient is put to bed in a quiet room with one low pillow and dentures are removed. No stimulants are given as intracranial hæmorrhage may be associated with concussion. A purge which encourages dehydration, such as calomel

or magnesium sulphate, may be given after the onset of reaction in mild cases In more severe cases a valuable method consists in the introduction into the rectum, by means of a syringe and rubber tube, of 3 ounces of magnesium sulphate dissolved in 8 ounces of water The fluid collecting in the rectum is siphoned off when necessary If severe headache persists lumbar puncture should be performed If urine is not voided catheterisation is necessary, as a full bladder encourages restlessness The patient should continue in bed on a light diet, and during this period in which signs of reaction, compression and cerebral irritation must be looked for, he should remain as undisturbed as possible his mental processes being reduced to a minimum Following severe cases prolonged mental rest is essential due regard being paid to the duration of post traumatic amnesia, the temperament and occupation of the patient

Compression.—This results, after injury from intra cranial hæmorrhage infection and depressed frac tures The increase in pressure may be due to the primary cause in certain cases but in addition the important factor of spreading œdema must be con sidered A head injury may be accompanied by a hæmorrhage over the cortex. If this is extensive it will compress the brain sufficiently to produce the characteristic clinical picture but if not, cerebral compression may result in the following way At first, the hæmatoma accommodates itself by ex pressing intracranial cerebro-spinal fluids and com pressing the adjacent cerebral veins When the pressure on these is sufficiently great venous con gestion is produced which stimulates the cortical area affected so that irritability is the first focal sign The venous back pressure produces œdema, which further increases the pressure on the veins which in turn causes more œdema, and so a vicious circle of spreading œdema is formed When the intracranial

pressure equals the arterial blood pressure, cerebral anæmia results, producing paralysis of the cortical area concerned Therefore a gradually spreading area of irritability is produced, followed by paralysis If the hæmorrhage occurs in the Rolandic area, there may be increased reflexes, rigidity, and twitchings of the limbs on the opposite side of the body followed by paralysis Bulbar stimulation finally results, with slow, deep breathing rise of blood pressure, and bradycardia

Clinical symptoms —Compression is frequently preceded by concussion Sometimes the latter gradually passes into the former, but there may be a *lucid interval* of some hours between the two The patient complains of headache, is sleepy, and passes into a state of coma, from which he cannot be roused The cheeks are flushed the skin moist breathing slow and deep becoming stertorous the pulse is slow, strong and the blood pressure raised The pupils are unequal that on the affected side being contracted at first, and later becoming widely dilated and fixed whilst the pupil on the unaffected side passes through the same stages The muscles on the opposite side to the injury are at first spastic, and later flaccid As pressure is transmitted through the brain it causes irritation of the Rolandic cells on the opposite side, so the muscles on the side of the injury become spastic, and if further pressure seriously damages the motor cells the corresponding muscles will become flaccid The temperature on the side of the body opposite to the lesion is usually a little higher than that on the same side

When the breathing is stertorous the lips and cheeks are puffed in and out with each respiration and eventually it becomes Cheyne Stokes's in type and gradually fails In these final stages the pulse becomes weak and rapid owing to anæmia of the cardio-vascular centre

Treatment —In mild cases the treatment should be expectant including quiet and rest in bed and the lowering of the intracranial pressure by rectal magnesium sulphate, intravenous hypertonic saline or glucose, lumbar puncture, or venesection In more severe cases the question of operation arises Two injuries which demand exploration are a depressed fracture and middle meningeal hæmorrhage Care and thought are devoted to discovering the nature and site of the compression so that no suitable case is 'missed' If localisation is impossible, reliance is placed on general measures and alimentary or intravenous dehydration bearing in mind that premature dehydration encourages intracranial hæmorrhage.

Cerebral Irritation.—This condition which is always preceded by concussion is believed to result from a cerebral contusion

The patient lies curled up on his side in a position of general flexion with his eyes closed He can be roused but resents it, uses strong language, and throws himself about He may pass his excreta in the bed, but occasionally requires catheterising Often he will take food left at the side of the bed but refuses it even when offered by a sympathetic nurse.

Treatment —Rest and quiet are essential The patient should be carefully watched, so as to prevent self injury Diet should be light and nourishing the bowels opened regularly and retention of urine treated by catheterisation Bromides, or even scopolamine or heroin are sometimes necessary to control restlessness

As in compression and the more severe cases of concussion prolonged mental rest afterwards is of the greatest importance if sequelæ are to be avoided or minimised but some degree of mental impairment is common

Coma.—Common causes of coma are

1 *Cerebral*—apoplexy, epilepsy, concussion, and cerebral compression

2 *Drugs*—alcohol, opium and its derivatives, barbiturates

3 *Constitutional*—diabetes, uræmia.

4 *Exposure* to excessive heat or cold

The features of the more important are as follows

Cerebral hæmorrhage (apoplexy)—The clinical appearance of the patient will be that of compression, but there will be no history of accident, the patient is usually of the plethoric type over 40 years of age with cardio vascular hypertrophy The condition would not be excluded by the presence of a skull wound as this may have been sustained after the hæmorrhage as the result of a fall Whenever there is any doubt, the patient should be confined to bed under observation for a few days

There is often conjugate deviation of the eyes towards the lesion, and albumin is sometimes present in the urine

The delirium of a cerebral hæmorrhage may be mistaken for alcoholic delirium If obtainable a history will be helpful, and it is useful to remember that the delirium of a hæmorrhage is quite uncontrollable, and will pass in a few hours into a state of coma, whilst that associated with alcoholic poisoning is generally controllable The smell of alcohol alone must not be considered conclusive proof of alcoholism as it may have been administered by a friend after the patient was taken ill, or possibly imbibed by the patient before the cerebral catastrophe occurred.

Coma following an epileptic fit—A history of the fit may be obtainable or of epilepsy in the past. The tongue is sometimes bitten and fæces and urine are often passed Scars on the head or tongue are indicative of previous fits

Cerebral embolism—The patient is usually a young adult often suffering from mitral stenosis and the

onset is commonly associated with a convulsion of which a history may be obtainable from friends There is occasionally evidence of emboli in other sites

Concussion and compression have been described — There will be a history of accident if it was witnessed by anybody, and there will probably be a skull wound Bleeding from the ears mouth or nose may be present

Alcoholism —The breath smells of alcohol the pupils are equal and dilated and an examination of the stomach contents is of great value If a history is obtainable from a reliable person the diagnosis is much simplified It is often possible to rouse these patients The alcoholic content of the urine and blood can be estimated

Opium poisoning —The pupils are pin point and the odour of opium may be detected in the breath Washing out the stomach will allow of its contents being examined and is an essential part of the treatment if the drug was taken orally Sweating is usually profuse but all other secretions diminished

Uræmic coma —This is characterised by contracted pupils cardiac hypertrophy and thickened arteries a somewhat sweetish smell of the breath dry mouth and tongue albumin in the urine drawn off by catheter and recurring convulsions The fundi should be examined for retinitis Intravenous infusion of isotonic sodium sulphate may tide the patient over the crisis

Diabetic coma —The patient is generally emaciated the breath smells of acetone the urine (drawn off by catheter) contains sugar acetone aceto acetic and oxybutyric acids and there may be a history of diabetes or treatment by insulin

HÆMATOMATA OF THE SCALP

(*a*) **Subpericranial.**—This type is limited to one bone generally a parietal, by the firm attachment of

the pericranium at the sutures It is a common birth injury and appears as a soft fluctuating swelling which in a few days presents a definite margin The presence of this margin, with the central depression suggests a depressed fracture, and if doubt exists, a radiograph should be obtained No treatment is necessary, absorption usually taking place in 8 months

(*b*) **Subaponeurotic** (subepicranial) —This hæmatoma limited by the attachments of the epicranium, is sometimes so extensive as to lift up the scalp As it is frequently accompanied by a fractured skull, radiographic examination should not be omitted

(*c*) **Subcutaneous.**—On account of the manner in which the skin is bound down to the epicranium by fibrous strands hæmorrhage is limited, and the hæmatoma necessarily small No treatment is necessary

Hæmatoma of the Ear (page 263)

Black Eye.—This is a subcutaneous extravasation of blood into the eyelids and is often accompanied by conjunctival hæmorrhage It should be treated by the application of cold and a firm bandage over cotton wool for the first 24 to 36 hours after which no further treatment is required

The importance of the condition is the possibility of its being confounded with a fracture of the orbital plate of the frontal bone However in black eye the bruising appears immediately after the accident, affects both lids and often the surrounding tissues, whilst *the conjunctival hæmorrhage has no particular* shape and its posterior limit can be seen In fracture of the orbital plate of the frontal bone bruising does not appear until after some hours, does not affect the upper lid nor the surrounding tissues (Fig 18) The subconjunctival hæmorrhage is wedge shaped the apex extending forwards to the cornea, whilst the

posterior limit is not visible Muscular movements may be impaired owing to the extravasated blood in the orbit

Although hæmatomata as a general rule require cold and pressure only in the first 24 to 36 hours and no further treatment aspiration or an incision for evacuation of the blood followed by pressure, is very useful in cases of large hæmatomata where a rapid recovery is necessary or a good cosmetic result essential The usual careful aseptic technique must be employed



Fig 18—Fracture of the anterior fossa with effusion of blood into both orbits, which appeared twelve hours after injury

Evacuation also diminishes the risk of subsequent infection

Scalds and Burns

Treatment is divided into general and local

General —In burns of any severity especially when the patient is a child severe shock commonly occurs and should receive the usual treatment of rest warmth and the alleviation of pain by the administration of analgesics. Infusion of saline or plasma is certainly helpful in many cases especially if the superficial wound is extensive Blood transfusion is contra indicated as the unwanted corpuscles merely cause capillary obstruction

Burns of the first degree.—A simple ointment such as boracic or zinc and castor oil is applied or the area is dusted with sulphathiazole powder

Extensive burns of the second or third degree.—The treatment of this major surgical emergency is gradually becoming clarified, and three methods now approved are the "closed" dressing the Bunyan bag and repeated saline baths It is now widely recognised that the application of tannic acid causes degeneration or actual necrosis of liver cells and coagulants discourage the growth of epithelium and so delay healing Moreover, infection is not abolished by coagulative treatment For these reasons the tannic acid spray and allied coagulants should be relegated to history

(1) "*Closed*" *treatment*.—Unless the patient is severely shocked an anæsthetic is administered and the burnt area is cleansed with spirit soap and cotton wool Dead or severely damaged tissue is removed and blisters are excised The area is then covered with pieces of vaselined gauze or gauze impregnated with 5 per cent boric acid Rolls of gauze must not be wound around a limb as if swelling occurs, constriction of the limb and interference with circulation will result Further layers of sterile gauze are applied and these are covered with a generous quantity of wood wool so that even pressure is obtained when the dressing is enclosed in a firm elastoplast or similar bandage The pressure of the elastic bandage inhibits swelling and discourages exudation of serum If the patient is suffering from severe shock débridment can be dispensed with and the dressings as described are applied directly to the burnt surface As a rule uneventful healing occurs, but scarring is more extensive than in cases where surgical measures can be adopted with safety A prophylactic course of chemotherapy is usually advisable in order to discourage infection

The dressing is left undisturbed for from ten to fourteen days, after which progress dressings are reapplied at weekly intervals, under rigid precautions against contamination by all in the vicinity of the patient

(ii) *Bunyan bag*—Severe burns of the extremities, especially in the neighbourhood of joints are frequently treated by means of the Bunyan bag (Fig 19) After cleansing the limb is enclosed in a special silk envelope which is transparent The envelope has inlets and

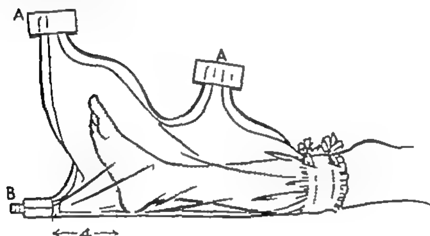


FIG 19—Bunyan bag for burn of leg A indicates inlets for introduction of irrigating solution, and B the outlet for drainage

outlets to enable the lesion to be irrigated with a flow of electrolytic sodium hypochlorite solution—Milton 5 per cent (Fig 19) This irrigation normally takes place twice a day The burn heals rapidly with a minimum of scarring and contractures are prevented by active movement of the parts affected

(iii) *Saline baths*—If the burn is very extensive and especially if on the trunk, the patient may be put in a saline bath at a temperature of 98° to 100° F This combats the shock, and allows the clothes to be soaked off Baths repeated twice daily yield excellent results, and on removal from the bath the patient is

placed on a sterile sheet, the affected surface is dried under a lamp and insufflated with sulphanilamide powder. The burnt area is then covered with vaselined gauze and a saline dressing, which is remoistened two hourly, and removed by soaking in the next bath. Those responsible for treatment should take precautions against infecting the burn by wearing a mask when the area is exposed.

Burns of the external genitalia are conveniently treated by the application of gauze impregnated with a sulphonamide ointment.

During the process of healing care must be taken to prevent contraction or stiffness of joints, and in some cases skin grafting is necessary. A high protein intake is indicated in order to compensate for protein lost by the outpouring of exudates and if necessary the diet is supplemented by infusions of plasma.

Bites

Insect bites are usually inflicted by wasps or bees. If anaphylactic symptoms arise 1 c.c. of 1:1000 adrenalin is urgently required. Bee venom is acid and should be neutralised by the application of soda or ammonia. On the contrary, wasp (and hornet) venom is alkaline, therefore vinegar or lemon juice is indicated.

Bites of animals such as the horse, cat and dog require the usual treatment of wounds. When there is the slightest suspicion of the animal's suffering from rabies the bite should be freely excised or cauterised with carbolic acid, solid silver nitrate, or the cautery. If possible the responsible animal should be kept under observation, or if it is killed Negri bodies may be found in the brain. Prophylactic treatment can only be obtained at a special Institute.

Snake bites should be treated by the immediate application of a tourniquet or constricting band proximal to the bite, after which the wound should be

excised and cauterised or packed with permanganate of potash crystals. Strychnine and other stimulants are required for the collapse, and an antiserum, if available, should be injected.

Miscellaneous Accidents

Foreign Bodies

1. *The œsophagus.*—If a food bolus is impacted it should be pushed on into the stomach by an œsophageal bougie. When a tooth plate, coin, safety pin, small toy, or piece of bone is lodged in the gullet, it should be localised by radiography as soon as possible, and removed immediately by means of the œsophagoscope.

In the case of small fish bones the expanding probang may be employed. This instrument is lubricated with a little glycerine, introduced closed, opened and then extracted.

2. *Trachea and bronchi.*—Foreign bodies in this situation should be localised by radiography and removed with the aid of bronchoscopy.

3. *Larynx.*—Generally the patient is black in the face and the condition requires urgent treatment. A finger should be passed into the pharynx and if the foreign body is felt it is hooked up. If unsuccessful no time should be wasted, but laryngotomy performed or high tracheotomy if the patient be a child. The foreign body, which is generally fixed in the glottis, may now be recovered by inversion of the patient and slapping the back, or by passing a bougie gently up through the wound and so dislodging the foreign body.

4. *Nose.*—A unilateral, blood-stained, purulent nasal discharge in a child is practically always due to the presence of a foreign body. If a speculum is introduced and reflected light employed it can usually be seen lying in the inferior meatus. If syringing through the opposite nostril is unsuccessful it should be removed by means of a hook or bent probe passed

gently into the nose above and then behind the foreign body A weak alkaline collunarium should be employed for a few days Occasionally Rouge's operation of incising between the upper lip and jaw and turning up the nose is necessary

E Ear—Not infrequently, foreign bodies are introduced into the external auditory meatus by children especially if they are solemnly warned that this is a dangerous procedure! Diagnosis is suggested by the history, deafness, tinnitus, vertigo, and sometimes discharge This is confirmed by inspection through an aural speculum by means of reflected light Removal can usually be accomplished by syringing along the roof of the meatus If a prolonged trial is unsuccessful, the child is anæsthetised and the foreign body dislodged with the aid of a blunt hook

Occasionally if the foreign body is impacted firmly the pinna must first be turned forwards by means of a posterior curved incision

Rupture of Tendons

Quadriceps Extensor Tendon.—This tendon is ruptured just above its patellar attachment At the site of rupture can be felt a gap which is increased by contraction of the muscle Loss of power of extension is obvious Treatment consists in open operation and suture

Long Head of the Biceps—Generally this is associated with osteo arthritis of the shoulder joint but not always in which case the rupture is usually near the union of muscle belly and tendon The diagnosis is obvious for when the arm is bent, the swelling formed by the contracted biceps belly is nearer the elbow than usual and much more prominent When osteo arthritis of the shoulder joint is present, no treatment is of avail as the tendon is thinned and frayed but in other cases open operation may be advised

Tendo Achillis.—This usually results from sudden severe strain although it occasionally occurs during such mild exercises as dancing when the nature of the injury may not be appreciated A gap can be palpated at the site of rupture and loss of function may be marked Treatment is operative but when this is contraindicated or impossible the patient should be confined to bed for three weeks, the knee flexed at a right angle and lying on its outer side on a pillow and the ankle strongly plantar flexed and strapped in that position

Plantaris Tendon is commonly ruptured during active games such as tennis Sudden severe pain is experienced and local tenderness can be detected in the calf three or four inches below the knee joint The calf muscles should be supported firmly with elastoplast and the patient is allowed to use the limb Recovery ensues in about three weeks

Supraspinatus Tendon occasionally ruptures especially in middle aged labourers Also rupture is sometimes associated with dislocation of the shoulder Unless the supraspinatus muscle holds the head of the humerus firmly in the glenoid cavity the deltoid is unable to abduct the arm and consequently contraction of the deltoid merely causes shrugging of the shoulder instead of abduction Local tenderness is experienced over the insertion of the muscle In early cases union will occur if the arm is fixed for 8 weeks in a position of right angled abduction and external rotation, otherwise suture is necessary if the full use of the limb is to be regained

Mallet or Dropped Finger—This condition is a rupture of the extensor communis digitorum tendon near its insertion into the dorsum of the base of the terminal phalanx, resulting from a blow on the top of the finger Sometimes the tendon does not give way but a fragment of bone is torn off at the site of insertion

There is inability to extend the terminal phalanx, which is always flexed

Treatment consists in the application of a "base ball" or thimble splint. A more satisfactory method is to fix the finger at right angled flexion of the proximal interphalangeal joint, with hyper extension of the terminal interphalangeal joint, so that the central slip of the extensor tendon is relaxed For this purpose the patient is shown how to press the thumb against the finger tip so that the correct position is maintained A dry tube of plaster is then slipped over



Fig 20—The treatment of "mallet finger (Cellona Technique T J Smith & Nephew Ltd.)

the finger and the hand dipped in warm water The wet plaster is then squeezed by the surgeon and the patient assumes the correct position until the plaster dries (Fig 20) The patient conducts his usual occupation and the plaster is removed in six weeks.

Tennis or Golf Elbow—This is a painful condition which results from several different causes, such as rupture of some of the fibres of the supinator brevis muscle traumatic fibrositis of the muscles attached to the external condyle and supracondylar

ridge especially the extensor carpi radialis and communis digitorum muscles These muscles seem to be affected chiefly as a result of back hand play, whilst those attached to the internal condyle are sometimes affected by strong fore hand play and playing with a "cut." Tearing of the deep head of the pronator radii teres muscle results from efforts to impart "top spin" on the ball Other causes are periostitis at the site of muscular attachment and arthritis of the superior radio ulnar joint There is usually pain on pressure over the affected spot

Treatment —The part should be bathed with hot water and massaged after which it should be strapped in the following manner Two pieces of strapping are cut, each 1¼ in wide With the elbow flexed slightly and the forearm supinated the first band of strapping is placed round the forearm at the junction of the middle and upper thirds The second piece is then applied so that it slightly overlaps the first. Before it is applied, it should have a semilunar portion removed so that the forearm may be strapped completely without limiting flexion The process of massage and strapping is repeated daily for a fortnight.

Some cases seem to be due to nipping of the synovial membrane by the orbicular ligament and immediate relief follows manipulation

More severe cases associated with arthritis and periostitis require the usual treatment of those conditions

Rider's Strain —This is a tearing of the adductor muscles especially the longus resulting in severe pain on any attempt being made to grip with the knees Extravasation is variable in amount, but may be very extensive whilst sometimes a small depression corresponding to the tear of the muscle, is seen and felt Treatment consists in strapping the whole of the thigh from below upwards with adhesive plaster

CHAPTER V

THE VASCULAR SYSTEM

HÆMORRHAGE

HÆMORRHAGE is either arterial venous, or capillary In arterial bleeding the blood escapes in spurts synchronous with the heart beats, unless the cut vessel is at the bottom of a deep wound in which case the latter rapidly fills with bright red blood

When a vein is divided, the blood flows out in a steady dark red stream spurting being absent except from the cerebral sinuses when it is synchronous with the pulse, and from the large veins of the neck, when the spurting synchronises with respiration

Capillary hæmorrhage is typified by general oozing from the surface

The general signs and symptoms of severe hæmorrhage are

1 Increasing pallor, especially affecting mucous membranes

2 Pulse—increasingly rapid and compressible

3 Steady fall of blood pressure

4 Restlessness

5 Dry lips and mouth, associated with thirst, which becomes intense

6 Air hunger

7 Tinnitus

8 Failing vision

9 Syncope

10 Temperature subnormal

Hæmorrhage may be **Internal** or **External**.—In the latter variety the escape of blood can be seen and the diagnosis is obvious but in the former type the blood

vessel and occurs in such conditions as infected wounds or amputation stumps, peptic or typhoid ulcers, and phthisis Radium necrosis is occasionally associated with secondary hæmorrhage, which is prone to occur when sloughs separate Frequently a "warning" escape of bright red blood is noticed Should this occur in a limb, a tourniquet should be arranged in position so that it can be tightened immediately if necessary Should hæmorrhage be severe the wound is opened in the hope that the vessel can be ligated Failing this, the wound is plugged firmly with gauze moistened with turpentine, which is gently removed about 4 days later A fresh piece of gauze should be at hand, so that it can be inserted speedily if necessary Recurrent bleeding requires ligation in continuity, and as a last resort the limb must be amputated

The Treatment of Hæmorrhage

First Aid

1 **Direct digital pressure** on the bleeding vessel This is the quickest method of arrest The part is rapidly exposed regardless of circumstances and one or two fingers are thrust into the wound so as to compress the bleeding artery preferably against an adjacent bone In the case of a limb a bystander or assistant can then apply a tourniquet.

2 **Pressure Points.**—For wounds in the scalp the severed artery is compressed against the bony skull Anatomical pressure points are of little value on account of the rich arterial supply and extensive anastomosis *Classical sites are as follows*

HEAD AND NECK.—The *common carotid artery* is compressed backwards against Chassaignac's tubercle (i.e. the anterior tubercle of the 6th cervical costo-transverse process) which is about 2½ inches above the inner end of the 1st rib and on the level of the cricoid cartilage

UPPER EXTREMITY —The *brachial artery* should be compressed in the middle of the arm in an outward and backward direction

against the humerus If the wound is too high to allow this the third part of the *axillary artery* may be compressed in a similar manner or if this is impossible the *subclavian artery* is occluded by pressure against the 1st rib in a downward and backward direction by the thumb above the clavicle or by some blunt article such as the handle of a padded door key

PALMAR hæmorrhage is dealt with by elevation and bandaging the hand over a door handle bandage cotton reel etc. The circulation in the forearm and hand can also be controlled by placing a pad in the bend of the elbow and flexing the latter over it

LOWER EXTREMITY —Hæmorrhage from the *external iliac artery* is controlled by pressure on the lower part of the *abdominal aorta* by the fist the assistant standing on a chair if necessary so that he may bring sufficient weight to bear without undue fatigue

The *common femoral artery* is compressed backwards and downwards against the horizontal ramus of the pubes at a point midway between the anterior superior iliac spine and symphysis pubis.

Hæmorrhage below the knee can also be controlled by putting a pad the size of a hen s egg at the back of the knee and fully flexing the joint

(*N.B* —The application of pressure to pressure points does not always stop hæmorrhage completely as the collateral circulation carries a variable quantity of blood past the site of pressure)

8 **Tourniquet.**—An *emergency tourniquet* consists of a pad which is placed over the main artery of the limb and held in position by a handkerchief through which a stick or similar object is pushed As the stick is twisted the handkerchief is tightened When hæmorrhage ceases the stick is fastened to the limb Emergency tourniquets should be loosened at half hourly intervals and all tourniquets are applied above the elbow or knee joint The middle of the arm should be avoided as at this site the radial nerve lies close to the bone A tourniquet must never be used to control venous hæmorrhage direct pressure with a pad and firm bandage is always adequate

Samway's Anchor Tourniquet—This consists of a rubber tube, to one end of which is attached a metal anchor. The limb is well protected by a folded towel or several thicknesses of cotton wool and the tourniquet then applied tightly round the limb and the end of the tubing hooked round the anchor.

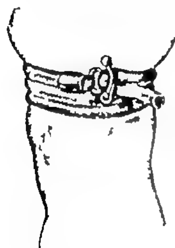


FIG 24—Samway's chain and anchor tourniquet (The customary towel is omitted for the sake of clearness.)

Esmarch's Elastic Bandage forms a very adequate tourniquet with little risk of deleterious pressure on nerves, and it is also used to render bloodless a limb to be operated upon. The elastic bandage is applied from below upwards, commencing at the fingers or toes and extending some distance above the operation site. At its upper limit, it is applied as a tourniquet, the bandage being removed except for the last few turns. An Esmarch's bandage can readily be improvised by cutting a suitable strip from the inner tube of a car tyre.

When used to prevent hæmorrhage during an operation the application of a tourniquet is likely to be followed by much oozing which can, however, be minimised by tight bandaging over a large dressing before the tourniquet is loosened, e g after removal of a cartilage from the knee joint. A sphygmomanometer is a very convenient and safe tourniquet for use during an operation. As the systolic pressure often rises as a result of operative interference, the pre-operative level plus 60 mm is adequate and higher pressures merely encourage local damage to the tissues.

Venous Hæmorrhage —Any obstruction between the wound and the heart in the form of garters, etc, is removed, the limb is elevated, and a pad applied to the bleeding site, and fixed in position by a bandage which is applied from below upwards and includes all that part of the extremity distal to the wound

CAPILLARY HÆMORRHAGE

The methods of arrest available are heat, cold hæmostatics, styptics and pressure

Heat is applied in the form of hot saline at a temperature of 120° F and is very useful in uterine and bone hæmorrhage It may also be used in the form of the cautery

Paquelin's thermo-cautery —This apparatus before the advent of electro-cautery and diathermy was in common use, but it is now almost obsolete

Galvano-cautery —This is a cautery, the heat of which is produced by the passage of an electric current through a loop of platinum wire in an insulated handle On the handle is a button by means of which the circuit can be opened or closed.

Although the cautery is very useful in this connection the possibility of secondary hæmorrhage following the separation of sloughs produced by the burn, must be remembered

Diathermy —The coagulating current is useful in controlling bleeding notably from solid viscera such as the liver or pancreas

Cold can be applied in the form of cold water or ice and is useful in nasal, buccal and pharyngeal hæmorrhage

Hæmostatics and Styptics

A hæmostatic acts by causing contraction of divided arterioles while a styptic coagulates blood

The following amongst many others may be used

Adrenalin 1 in 1 000 solution (hæmostatic)

Liquor ferri perchloridi fortis (styptic)

Hæmoplastin and serum (hæmostatics)

Wright's styptic, which consists of extract of thymus testis calcium chloride, sodium carbonate, and carbolic acid

Tinctura hamamelidis (hæmostatic)

Snake venom, obtained from the Russell's viper (stypven) A small crystal is dissolved in saline and applied to the bleeding surface It is particularly useful in hæmophilia

Pressure —Cavities may be packed from the bottom with ribbon gauze and a firm dressing applied The packing is removed after 48 hours In amputations the oozing surfaces are apposed and pressure applied in the form of a firm stump bandage.

Reactionary Hæmorrhage

Reactionary hæmorrhage is treated in the same manner as primary hæmorrhage

Secondary Hæmorrhage

If a wound of a limb is infected, and there is a possibility of secondary hæmorrhage a tourniquet should be loosely arranged above the wound and attendants and nurses should know how and where to apply it For psychological reasons the patient should be unaware of these preparations The dressing should be light the bandage firm and the part elevated whilst if the patient is having baths a careful watch should be kept as severe hæmorrhage into the bath can take place with no other symptom than a pleasant feeling of languor Should hæmorrhage occur treatment is conducted on the lines suggested (page 84)

The General Treatment of Hæmorrhage

The patient should be kept quiet and warm, and if the hæmorrhage has been severe the foot of the bed is

raised, to encourage an adequate blood supply to the cerebral centres, and the limbs bandaged from the distal ends to the trunk. If the patient is aware of an impending crisis he should be cheerfully reassured. This is not only humane, but fear or fright causes elevation of the blood pressure and so encourages bleeding.

Morphia is very useful in quieting the patient and preventing a rise of blood pressure and is especially valuable in pulmonary and gastro intestinal hæmorrhage in which surgical treatment may be impracticable.

Stimulants, oxygen, or infusion must not be given until the hæmorrhage has been arrested, except to tide the patient over a crisis pending operation.

Infusion.—The loss of fluid from the body may be replaced by fluid given by the mouth, rectum, intravenously and subcutaneously.

1. *Mouth.*—The patient should be allowed to take plenty of fluids, and in many cases this is quite sufficient.

2. *Rectum.*—Saline may be administered continuously or repeatedly.

Continuous rectal saline is conveniently administered by the following method.

A rubber tube or catheter is passed into the bowel for about 6 inches and connected with the delivery tube of the apparatus, a useful form of which to keep the saline at the necessary temperature of about 110° F is a Thermos flask, from the bottom of which leads the rubber delivery tube. This is provided with a clamp by which the rate of flow is regulated so that a pint of saline is allowed to flow into the rectum in about 1 to 1½ hours.

Repeated rectal saline injections may be given 4 hourly. If no chloride depletion exists owing to excessive sweating, vomiting or other causes, *tap water* is absorbed more speedily. The pelvis is raised

on a pillow and a rubber tube or catheter passed into the rectum a funnel is attached to the tube and saline at a temperature of 100° F allowed to run in In a child of 1 year, 4 oz. may be given 4 hourly and in an adult, about 1½ pints at similar intervals The rate of flow should be about 1 pint in 20 minutes If given more quickly, the injection may act as an enema

Intravenous saline is described in the section on Minor Operations The fluid may be given through a needle introduced subcutaneously into a vein, but if as sometimes happens after severe hæmorrhage it be impossible to see or feel a vein exposure by an incision will be necessary

Subcutaneous saline (hypodermoclysis) may be given into the subcutaneous tissue of the abdominal wall, *submammary region and thighs* *The apparatus* required is similar to that for continuous rectal saline administration with the exception that the rubber tube leading from the Thermos flask is connected with two rubber tubes carrying large sized needles The whole of the apparatus and saline having been sterilised and the skin having been prepared for operation, the needles are pushed into the tissues to be infiltrated (for example, one needle below each breast or into each flank or thigh) and maintained in position by strapping the tubes to the skin A sterile dressing should surround each needle whilst any resulting swelling from the injection should be lightly massaged

It is important to see that the tubes and needles are full of fluid at the time of inserting the needles, and this is best ensured by allowing the saline to run from the needles as they are introduced About one pint is injected in an hour and the saline may be given for many hours provided that a check is kept on fluid intake and out put, so that pulmonary œdema is guarded against

In more severe cases of hæmorrhage blood trans-

fusion is of much greater value than saline infusion (page 147)

Tooth Socket—Bleeding from a socket after extraction is sometimes very troublesome and should be treated by removal of all clots and firm plugging with sterile ribbon gauze dipped in 1 in 1,000 adrenalin A thick pad of gauze is then placed in the gap made by the absent tooth and firmly bitten upon by the patient, or a barrel bandage may be applied Styptics such as Wright's or stypven may be used if necessary, or even the actual cautery

Hæmophilia—Sometimes the patient is a hæmophilic, in which case 10 c c of blood, horse serum, or diphtheria antitoxin may be injected subcutaneously and calcium chloride given intramuscularly and by the mouth Blood transfusion is valuable, and if the bleeding surface is accessible stypven is applied

The Lip—Bleeding from a cut lip may be very severe but is easily controlled temporarily by compressing the lip between the finger and thumb on each side of the cut The bleeding point should be ligated and the lip sutured The first stitch introduced should be a horse hair suture at the junction of skin and mucosa, after which the skin part of the wound should be sutured with horse hair and the ends left long so that they may be pulled upon to evert the lip and allow the mucosa to be sewn with catgut Whitehead's varnish is applied as a dressing one thickness of gauze being used on the skin if considered necessary

The Tongue—Considerable hæmorrhage may accompany wounds of the tongue, and is controlled by pressing downwards and inwards at the side of the tongue with the fingers which at the same time pull the tongue forwards Generally the bleeding can be permanently arrested by suturing the wound with chromic-gut stitches, which pass deeply into the substance of the tongue Should the bleeding follow an

operation for excision of the tongue, the latter should be pulled forward in the manner described and a suture (if not already there) passed through the tongue to hold it forward. The bleeding points are seized with Spencer Wells's forceps and ligated or under run with a stitch. Secondary hæmorrhage, which sometimes follows the application of radium, may be very persistent, and if all other measures fail, the lingual artery must be ligated at its origin from the external carotid, i e proximal to the dorsal branches to the tongue, or the external carotid artery is ligated.

The Face—Bleeding is often free, but can be controlled by the usual means. Wounds of the face, unless very small, should be neatly sutured with horse hair to prevent a broad scar. The stitches are removed on the third or fourth day.

Cut Throat—Most commonly this is met with in attempted suicide. The larynx is involved much more frequently than the great vessels of the neck, because the would be suicide throws his head back just before cutting, this rendering the larynx prominent. Also, the incision usually is made in the upper part of the neck where the larynx is superficial and the great vessels deep.

The size of the skin wound is no guide as to the severity of the condition, in that a wound extending almost from ear to ear may only involve skin and subcutis, whilst a wound of 2 inches in length can involve trachea and œsophagus.

Cut throat must be treated according to the principles laid down for the treatment of any wounds.

If the air passages are not involved, bleeding points should be ligated, muscles sutured, and the wound closed after insufflation with sulphonamide powder.

If the air passages are involved, the commonest site of injury is the **thyro-hyoid space**, in which case the pharynx is opened. Hæmorrhage may occur from the superior thyroid, lingual, and facial vessels and

the hypoglossal and internal laryngeal nerves are sometimes divided, the former injury causing paralysis of the muscles of the tongue on the side affected

Treatment —Hæmorrhage must be arrested nerves if possible repaired the thyro hyoid membrane carefully sutured and drainage provided in the form of a small tube In severe cases, in which the thyroid cartilage falls away from the hyoid it may be necessary to suspend the former from the latter by means of strong sutures

If the **trachea** is involved the contents of the carotid sheath may be divided as also the thyroid gland recurrent laryngeal nerves, and inferior thyroid veins Death is apt to occur rapidly from hæmorrhage or suffocation due to the passage of blood into the trachea

Treatment —This follows along the usual lines In addition a tracheotomy tube should be introduced through the wound in the trachea and the latter sutured (if necessary) round the tube

When the thyroid cartilage is divided the usual treatment of a wound is carried out and the mucous membrane of the larynx and the thyroid cartilage carefully sutured If the wound is contaminated or comes under treatment many hours after infliction a high tracheotomy should be performed

Important points in the after treatment include flexion of the neck, by suitably arranged pillows and the general treatment of shock and hæmorrhage A prophylactic course of sulphonamide or penicillin is often prescribed in order to forestall infection After the immediate danger has passed bronchopneumonia may ensue Surgical emphysema is uncommon and requires no treatment

Infection of the wound may occur and is sometimes complicated by œdema of the glottis or mediastinitis Free drainage must be provided and tracheotomy may be necessitated by glottic œdema

The Scalp—Hæmorrhage in these cases is usually severe and owing to the attachment of the vessels to the fibrous subcutis, it is usually impossible to apply a ligature Bleeding is however, always easily controlled by under running the vessel with a stout silkworm suture on a curved needle and tying it tightly

Punctured Wounds of the Wrist—Not infrequently window-cleaners people who bottle mineral water, and others suffer from wounds of the radial and ulnar arteries at the wrist These may heal leaving a weak *cicatrix in the vessel wall which yields later with the* formation of an aneurysm, or the extravasated blood may clot peripherally leaving a cavity communicating with the lumen of the artery a condition described as a false traumatic aneurysm

Treatment—A tourniquet having been applied the aneurysmal sac is exposed and removed, and the artery is divided and ligated proximally and distally

Intercostal Arteries.—These lie in grooves along the inferior borders of the ribs their position preventing the simple application of a ligature

As a temporary means for the arrest of hæmorrhage a piece of aseptic gauze is pushed between the ribs and strips of gauze packed into the pocket formed, until the latter is too big to be withdrawn When pulled upon it exerts pressure on the bleeding point. If necessary, subperiosteal resection of a piece of rib allows exposure and ligation of the divided artery

Varicose Veins

Varicose veins commonly give rise to no symptoms or complications Treatment may be required on account of an associated sensation of weight or fatigue for cosmetic reasons or to control such complications as dermatitis

Treatment—(i) Palliative (ii) Injection (iii) Simultaneous ligation and injection, (iv) Excision

Each of these forms of treatment has its indications

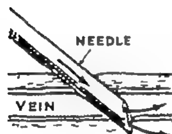
and contraindications and sometimes a combination of methods is desirable

(i) *Palliative treatment* is adopted if the predisposing cause is transitory, e g pregnancy, or if the deep veins have been occluded by thrombosis In the latter case, the patient will recall an illness or pregnancy in which the leg became swollen and painful, necessitating immobilisation in bed Not infrequently some permanent swelling of the limb persists In such a case the varicose veins are the main channels for the return of blood, so injection or operation is harmful, and certain to be followed by recurrence as other compensatory collateral veins develop

Palliative treatment consists in avoiding any constriction, such as tight garters, and the application of a crêpe bandage which is applied from below upwards Porous elastic stockings are useful, but rubber bandages or stockings interfere with the evaporation of perspiration and so predispose to dermatitis

(ii) *Injection* —This method yields good results if valves are competent a state of affairs which can be ascertained by means of Trendelenburg's test The patient is recumbent and the leg is elevated so that superficial veins are emptied The saphenous vein just below the opening is compressed either digitally or by means of a piece of medium sized rubber tubing (Fig 25 1) The patient stands (Fig 25, 2) and the occlusion is then removed Rapid filling of varicosities from above downwards indicates valvular incompetency (Fig 25, 3) and combined ligation and injection is necessary Slow filling of the veins from below indicates that the valves are efficient and injections alone can be carried out with confidence The protection afforded by the valve at the upper end of the external saphenous vein can be tested in a similar manner by applying pressure over the veins as it dips into the popliteal fossa to join the popliteal vein

60 mm of mercury When the veins are prominent, the recumbent position is assumed and the skin over the selected site of injection is cleaned with spirit The filled syringe is taken the needle inserted into the vein and a little blood withdrawn, indicating the position of the needle in the lumen of the vein The sphygmomanometer pressure is released, the vein above the needle is emptied upwards by massage and the injection is made Small or medium sized veins are injected while the patient is standing, but large veins should be treated by the "empty



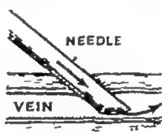


Fig 26—A common cause of perivenous injection.

vein" technique This method permits the maximum concentration of solution to be brought in contact with the intima, and the formation of bulky and knotty clots is avoided After the needle is withdrawn the puncture is compressed with a swab moistened with spirit, and a strip of elastoplast dressing is applied for a few hours

The first injection is made at the lowest point in the group and succeeding ones progress from below upwards The initial dose should not exceed more than 1 c c of quinine and urethane solution, lest the patient be unusually susceptible to the substance Subsequently the amount is increased up to 8 c.c. or more than one injection of a smaller amount at

different points may be given at the same sitting It is essential that the injection be strictly intravenous Perivenous extravasation may lead to severe local irritation infection and ulceration It is sometimes due to the bevel of the needle being partially outside the vein In all intravenous injections the needle should be introduced so that the bevelled extremity is parallel to the wall of the vein (Fig 26) Should extravasation occur the barrel is detached from the needle refilled with normal saline 2 or 3 c c of which is injected into the affected area so as to dilute the solution and minimise the irritating effects Injections are usually given at weekly intervals

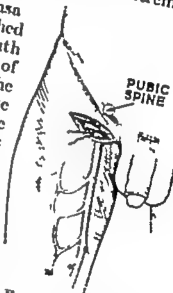


Fig 27.—Ligation of the internal saphenous vein as a preliminary to injection.

Ligation-Injection.—Under suitable anæsthesia an oblique incision up to 2 inches in length is made over the saphenous opening the centre of the incision being vertically below the pubic spine (Fig 27) The vein is exposed and the absence or presence of duplication is noted All tributaries entering the vein are carefully ligated The vein is then divided between ligatures and it is a wise precaution to ligate doubly the proximal end There are no valves in the veins between the ligatures and the right auricle so post operative venous congestion e g coughing results in a sudden engorgement of the vein at the site of ligation Serious venous hæmorrhage has followed slipping of a single ligature Some surgeons prefer transfixion of the vein in order to avoid this complication The lower ligature is not divided immediately

as it is useful for exercising traction on the vein and a suitable injection is then introduced into the distal part of the vein If varices are present in the lower part of the thigh they can be conveniently treated by the introduction of a ureteric catheter through a snick in the wall of the vein The catheter is in sinuated along the lumen and injection is made at the desired level The ligature on the distal end of the vein is then divided the wound is closed and an adhesive dressing is applied No rest in bed is required after the operation, and subsequent further injections are given as necessary As previously mentioned, ligation of the external saphenous vein is occasionally required The position of the vein should be previously marked on the skin, either by means of silver nitrate or a suitable dye A vertical incision is made over the vein the popliteal fascia is divided and the vessel is ligated close to its entry into the popliteal vein

(iv) *Excision* of veins is undertaken for the following conditions

(*a*) Varices —A large single varix or multiple varices are unlikely to respond to injection therapy

(*b*) Massive veins —These may be as thick as a finger Even if the "empty vein technique is used aseptic thrombosis causes considerable dis comfort, and some months may elapse before resolu tion is satisfactory

(*c*) Failure of injection therapy —Some veins appear to be irresponsive to injection. Recanalisa tion is apt to occur if treatment is incomplete, or if *some degree of valvular incompetency* exists a condition which may be difficult to detect in a fat thigh However symptoms are often relieved even if recanalisation occurs, owing to thickening of the venous wall by fibrosis.

(*d*) Ectasia —This term is applied to increase in the size of the vein following valvular incompetence It

differs from varicosity in that the vein is straight and the walls are thick Ectasia commonly occurs in young athletic males, and even if injection causes temporary improvement, recanalisation is the rule

VARICOSE ULCERS

Most varicose ulcers heal eventually if treated by elastic compression of the leg and adequate treatment of the varicosities The ulcer is cleansed with spirit the skin is shaved if necessary, and an adhesive plaster is applied in a spiral fashion from the root of



FIG 28.—Carcinoma supervening on a varicose ulcer of twenty years duration.

the toes to just below the knee joint each turn of the bandage overlaps the preceding turn by half to two thirds of its width The degree of firmness with which the bandage is applied is a matter of experience but if œdema is present a little extra tension is advisable as exudate will absorb as a result of pressure If tightness is distressing to the patient, a few hours elevation of the leg will relieve the discomfort The treatment is ambulatory, and the bandage is changed when laxity or foulness of the discharge renders the procedure necessary If the adhesive plaster causes dermatitis Unna s zinc gelatine paste should be applied and covered with an elastic bandage Viscopaste bandages are a useful substitute

Even in these enlightened days, some patients, either through neglect or dread of hospitals, ignore even such a condition as a foul and discharging varicose ulcer In such cases the underlying bone may become involved with resulting periostitis, or eventually carcinomatous changes are apt to supervene on the chronically infected ulcer (Fig 28)

CHAPTER VI

CELLULITIS AND ABSCESS

CELLULITIS is a spreading inflammation of the subcutaneous or other cellular tissues usually due to infection by the streptococcus pyogenes which has gained entrance through a wound sometimes so small as to be invisible

The incubation period in very acute cases may be 2 or 3 hours whilst in less severe types it is about 2 days

The symptoms are general manifested by rise of temperature pulse and respiration rate headache, malaise and sometimes a rigor and local, consisting of redness swelling heat and pain surrounding the wound Œdema is present and the part which at first is brawny may later become soft The red blush passes gradually into the surrounding tissues and is not sharply limited as is usual in erysipelas Acute inflammation of the lymphatic glands draining the part is usually present In the very severe cases which are predisposed to by debility and fasting repeated rigors may occur and if the toxæmia is intense, the patient s temperature may be subnormal

Treatment.—The general treatment of acute inflammation should be carried out including rest under the best hygienic conditions light nourishing diet aiding the excretion of toxins by the judicious administration of aperients diuretics and diaphoretics A sulphonamide preparation e.g sulphadiazine four tablets (2 gm) initially followed by a maintenance dose of two tablets four hourly for three or four days A copious fluid intake is desirable and if the treatment

is prolonged, or requires repetition, examination of the leucocytes is necessary in order to exclude damage to the white blood cells

Chemotherapy may require the awakening of a sleeping patient If such is necessary for this or other causes, violent measures such as shaking should be avoided A patient who awakes with a "start" is mentally and physically irritated and considerable time must elapse before he regains his

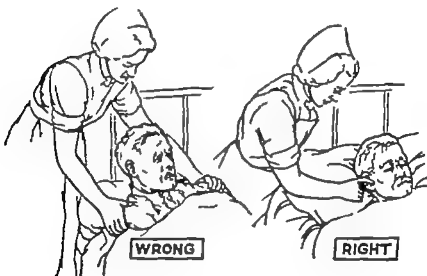


Fig 20 —Waking a sleeping patient

composure The ideal method of arousing a sleeping patient is by increasing digital pressure on the tragus as a result of which the patient wakes up quietly and sometimes even with a smile !

If vomiting prevents oral administration some intravenous preparation such as soluseptasine, is prescribed Penicillin should be administered if the response to chemotherapy is not satisfactory

Locally hot fomentations hot baths or Bier's passive hyperæmia all have their uses Incision is harmful until pus forms for premature interference will merely open up paths of infection which the

patient is attempting to obstruct by a leucocytic barrier, and incisions enhance the liability to septicæmia

If diffuse suppuration occurs, multiple deep free incisions are made parallel to the main blood vessels and nerves This is followed, if the limbs are involved, by hot hypertonic saline baths for limited periods Prolonged soaking renders the skin sodden and diminishes its vitality

Cellulitis of the Scalp—Nearly always follows a wound of the scalp and may affect either the subcutaneous or the subaponeurotic tissue the so-called "danger space" In the former, the inflammation remains localised and resembles *cellulitis affecting* other subcutaneous tissues but in the latter, pus forms beneath the aponeurosis being limited by the attachments of the latter and therefore able to extend as far forward as the *superciliary ridges*, backwards to the superior curved line, and laterally to the zygomata It is at these attachments that swelling and œdema are most marked and abscesses usually point rarely the whole scalp actually floats on the pus There is severe constitutional disturbance General treatment is instituted and if incisions are necessary they should be parallel to the main vessels sufficiently deep to open up the areolar space beneath the epicranial aponeurosis

If suppuration occurs, the need for early surgical interference is obvious as necrosis of skull, sinus thrombosis and meningitis are possible sequelæ

Cellulitis of Orbit—Most commonly this is due to extension of suppuration from ethmoid disease It may also follow perforating wounds, osteomyelitis, or compound fracture

The orbital tissues become infiltrated and swollen proptosis results the eye being fixed and painful Œdema and congestion of the lids and conjunctiva are present (chemosis) together with diplopia and

diminished vision Corneal ulceration and panophthalmitis may follow, and if suppuration occurs—there is danger of cavernous thrombosis and meningitis General disturbance is present but variable in degree

Treatment consists in the immediate application of general measures If necessary an incision is made over the place of maximum swelling and may be through the conjunctival fornices or lids When the condition is secondary to ethmoid disease, the incision is made at the supero internal angle of the orbit through the lid and palpebral fascia between the trochlea of the superior oblique tendon and the tendo oculi (internal tarsal ligament) (Fig 80) A small rubber-glove drain is inserted Fomentations are then applied If suppurative panophthalmitis occurs, the globe should be freely opened by a crucial incision This is safer than enucleation, as the latter entails a greater risk of meningitis

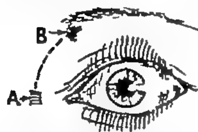


FIG 80—Orbital cellulitis secondary to ethmoid disease The incision lies between B (the trochlea) and A (the tendo-oculi)

Cellulitis of Axilla.—This is due either to an infected wound of the upper limb or extension from an axillary lymphadenitis The axillary tissues become firm and brawny and redness and œdema extend over the chest and back to a variable degree Pain is severe and aggravated by attempts to abduct the arm Suppuration tends to spread under the pectoral muscles and may also involve the shoulder joint, causing a suppurative arthritis

Treatment—If suppuration is suspected an incision is made through the skin of the floor of the axilla parallel to its anterior fold The deep fascia is incised and sinus forceps are introduced pus being

evacuated If necessary, the incision is enlarged to ensure free drainage

Stiffness of the arm is avoided by keeping the arm partly abducted, and passive and active movements are encouraged when the acute inflammation has subsided

Cellulitis of Neck.—This may follow pharyngeal, tonsillitic, or dental infection osteomyelitis of the mandible, cervical lymphadenitis, inflammation of the submaxillary salivary gland and wounds

A brawny swelling develops the skin becoming red and œdematous Pain is severe the head fixed and inability to open the mouth dysphagia, and dyspnœa are common symptoms Severe general constitutional disturbance is usually present

Œdema of the larynx and spread of infection beneath the deep cervical fascia to the mediastinum or pericardium are serious complications

Treatment—If pus is suspected a suitable exploratory incision is necessary Pentothal is suitable for most cases

Tracheotomy instruments must be at hand ready for immediate use A careful incision is made over the site of greatest swelling and tenderness down to and *through* the deep fascia A director or sinus forceps is passed through the opening in varying directions until pus if present is found and the abscess is drained.

When the condition affects the submaxillary region and spreads forwards beneath the chin involving the floor of the mouth and base of the tongue it is known as Ludwig's angina Œdema of the larynx is especially liable to supervene therefore operative interference is urgently called for

Erysipelas

Erysipelas is a spreading inflammation of the skin and subcutaneous tissues due to infection by one of

the streptococcus pyogenes group The organisms frequently gain entry to the tissues through a small or neglected wound, but in some cases no breach in the skin is discoverable The general health of the patient is usually below par, and debilitating diseases the extremes of life, and poor hygiene are prominent predisposing conditions

Symptoms—The patient notices that the skin in the vicinity of a scratch or abrasion has become irritable and feels stiff After a few hours general symptoms of toxæmia supervene which usually increase in severity until the patient is obviously ill or even delirious

Signs—If the infection commences in a wound this will exhibit an unhealthy appearance, and from the margins a rose pink rash extends over the adjacent skin The edge of the rash is definite a feature which is often more easily appreciated with the finger than the eye The colour of the rash and its definite edge are important points in distinguishing a true erysipelas from cellulitis As the rash extends vesicles appear, which burst and discharge serum

Considerable swelling occurs when lax tissues are involved particularly the orbit and the scrotum, which may become as large as a fœtal head The rash gradually fades and for some weeks a brown dis coloration of the skin remains due to pigment set free as a result of destruction of red corpuscles Adenitis invariably accompanies the infection, but suppuration of the glands is unusual

In some cases the infection wanders about the body perhaps for months (erysipelas migrans)

Treatment.—Erysipelas is a contagious disease and therefore the patient should be isolated or at all events removed from a surgical ward Care must be taken during dressings to prevent contamination and those who dress the wound must use gloves for their own as well as others safety Surgeons and

accoucheurs must be particularly careful, as organisms are apt to be conveyed to other patients, even after every precaution, sometimes with tragic results

General treatment is directed towards improving the health of the patient in every possible way A suitable diet mild aperients adequate ventilation, sulphapyridine, and stimulants all receive due consideration Anti streptococcal serum is rarely necessary, as most cases respond readily to chemotherapy or penicillin Collosol manganese injections are useful in recurrent or long-standing cases

Ichthyol ointment is commonly used as a local application and relieves pain and stiffness Gauze soaked in a saturated solution of magnesium sulphate is also a very satisfactory dressing

Abscess

An abscess is a localised collection of pus, and is either acute or chronic The former is most commonly due to the staphylococcus pyogenes but may result from infection by the streptococcus, pneumococcus bacillus coli communis and other organisms A chronic abscess is usually due to the tubercle bacillus The signs and symptoms of *acute abscess* are general and local the former including increased temperature pulse, and respiration rate, malaise, loss of appetite, and constipation and the latter redness, swelling heat pain and loss of function, according to the position of the abscess

There is only *one* definite physical sign, on which can be diagnosed the presence of pus and that is fluctuation in two planes it being remembered that fluctuation can normally be obtained across but not in the line of, a muscle

Other points which help in determining the presence of pus are (*a*) the pain becomes throbbing in character (*b*) superficial œdema is marked and increasing (*c*) the temperature tends to swing' (*d*) leucocytosis

(*e*) the duration of the condition—if inflammation does not subside in four or five days, pus is probably present

Treatment—The usual general treatment of acute inflammation is carried out

As a general rule pus is evacuated as soon as its presence is diagnosed There are certain exceptions to this, e g hypopyon or pus in the anterior chamber of the eye, and, according to many surgeons, selected cases of appendicular abscess It must constantly be remembered that the administration of penicillin and chemotherapy can mask the presence of pus which although more or less symptomless, should in most cases be evacuated without undue delay

The skin of the patient having been prepared in the usual way and rigid asepsis being maintained an adequate incision is made into the abscess, the pus evacuated and a finger introduced, septa being broken down and a multilocular converted into a single cavity A drainage tube corrugated rubber, or piece of rubber glove drain is inserted

If the position of an abscess is such that during operation important structures are endangered, e.g in certain abscesses of the neck, axilla, groin and popliteal space **Hilton's method** should be employed

An incision is made through the skin and subcutaneous tissue down to the deep fascia, which is then carefully opened A grooved director or sinus forceps is passed through the opening in the deep fascia in the direction in which pus is suspected and as soon as the pus escapes the aperture is enlarged If necessary a finger is introduced and any septa broken down Suitable drainage is obtained by means of a rubber tube corrugated rubber or a glove drain

The primary focus may require treatment, e g an abscess of the neck is commonly secondary to infection

of the tonsils or teeth in which case tonsillectomy, extraction or filling will be indicated

Abscess of Neck.—This is a very common condition generally occurring in the upper part of the neck. Most frequently the anterior triangle is concerned, the abscesses being *submental* secondary to infection of the chin, lips, gums, and teeth, *submaxillary* secondary to infection of the maxillary and mandibular skin areas teeth, tongue, and gums (frequently the abscess does not originate as a suppurative lymphadenitis but results from extension of an external alveolar abscess) *upper deep cervical* i e behind and below the angle of the jaw partly under cover of the sterno mastoid secondary to infection of the tonsils, face ear Certain members of this group are situated a little higher and are due to infection from the nose and pharynx

Abscesses in the upper part of the posterior triangle are common, being due to infection from the scalp Pediculi capitis were formerly a common cause

In dealing with these, Hilton s method is usually applicable

Incisions are made where possible, in the creases of the neck, so that in the anterior triangle they will tend to be horizontal

In the posterior triangle abscesses in the upper third may be opened by horizontal or vertical incisions in the middle third by an incision running downwards and backwards in the line of the external jugular vein and in the lower third by an incision along the posterior border of the sterno-mastoid or horizontally just above the clavicle

Retropharyngeal Abscess.—The acute form is found in children and is due to infection of the retropharyngeal lymphatic glands which drain the naso-pharynx and pharynx. These glands atrophy after the age of 2 years The diagnosis must always be borne in mind if a small child who has had a cold develops dyspnoea and dysphagia If an abscess is present examination

in a good light will reveal a red elastic swelling and later, fluctuation Unless promptly opened, death is possible either from œdema of the glottis, asphyxia, or aspiration pneumonia should the abscess rupture spontaneously The patient should be enveloped in a blanket and placed in the supine position, with the head hanging over the end of the table The mouth is opened with a gag, no anæsthetic being administered The surgeon requires a head lamp and a spatula to depress the tongue The points of a pair of angled sinus forceps are plunged into the swelling (Fig 31) and the infant is immediately held up by the legs so that pus runs out of its mouth and nose

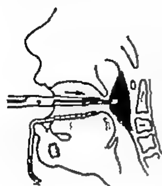


Fig 31 —Opening a retropharyngeal abscess.

Quinsy or Peritonsillar Abscess.—This should be opened at a point on a line between the base of the uvula and the last upper molar tooth a little nearer the former than the latter It should be remembered that the tonsil is often pushed forwards by the abscess consequently the tonsil is frequently explored instead of the abscess cavity Two methods may be employed (*a*) that of pushing in a pair of angled sinus forceps (Fig 32) or (*b*) that of incising upwards

Fig 32.—Opening a quinsy with sinus forceps.

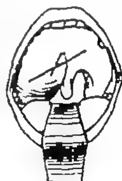


Fig 33. — The dotted line indicates the incision for opening a quinsy

and inwards (i e in the line of the anterior pillar of the fauces) with a sharp pointed curved bistoury guarded to within a third of an inch of its point (Fig 33) Whichever method is used, anæsthesia can be produced by the application of 10 per cent cocaine on a soft brush, several times at intervals of about 2 to 3 minutes Sinus forceps are rather safer than a bistoury and they are pushed backwards and upwards under the base of the uvula towards the upper part of the posterior pillar of the fauces When pus is found the forceps are opened widely and the patient s head held forwards Warm gargles are prescribed

The painting of the tonsillar region with liquor ferri perchloridi fortis seems occasionally to abort a peritonsillar inflammation which is threatening to suppurate

Abscess of Axilla.—An axillary abscess is opened by Hilton s method as described on page 110

Abscess of Iliac Glands.—Suppuration can occur without obvious enlargement of the inguinal glands, owing to infection having ' jumped ' this latter group of glands Psoas spasm is common and a mass is palpable above Poupart s ligament The condition has been mistaken for an appendix abscess Pott s disease and arthritis of the hip joint When suppuration is suspected the abscess is carefully opened by an extraperitoneal incision above Poupart's ligament

Abscess of Groin.—There are two common types One occurs over the inner part of Poupart's ligament, and is a suppurative condition in and around the medial set of the horizontal chain of superficial inguinal glands It is usually secondary to infection of the external genitalia or anal region The other is below Poupart's ligament and involves the vertical chain of glands and follows infection of the toes, dorsum and inner side of the foot front and inner side of the leg and entire thigh

The former is treated by an oblique incision down

wards and inwards, the latter by a vertical incision which gapes when the thigh is flexed, so that drainage is unhampered

Popliteal Abscess —This is not common and when it occurs, is usually secondary to infection of the outer side of the foot, or of the leg It is opened by Hilton's method through a posterior vertical incision, and although swelling may have been negligible owing to *the strong transverse fascia, nearly a pint of pus may* be evacuated

Some surgeons advocate an incision on the outer side of the space in front of the biceps tendon

Popliteal aneurysms occasionally occur especially in elderly people An uncomplicated aneurysm is unlikely to be misdiagnosed but a hæmatoma resulting from slight leakage may become infected Therefore a popliteal 'abscess' in a patient past middle age must be approached with caution

Prepatellar Suppuration.—This frequently com *mences as an infective bursitis of the prepatellar* bursæ spreading through the wall of the latter and involving the surrounding cellular tissue Other causes include abrasions and cuts of the overlying skin A free vertical incision is required although sometimes it is wiser to replace this by two lateral incisions It is advisable to warn the operator of the possibility of a carelessly made incision involving the joint and causing a suppurative arthritis

In more severe cases, where there is a sympathetic effusion into the joint, the extremity should be slung with the knee slightly flexed in a Thomas's knee splint and extension applied to the leg *The patient's* discomfort is thus diminished

Mammary Abscess.—This is most often observed during the first few weeks after parturition and usually results from infection by organisms (generally staphylococci) through a sore nipple Most cases are due to the unnecessary swabbing of the baby's gums Small

abrasions are thus caused, which become infected and consequently the child inoculates the mother Treatment consists in weaning the baby withdrawal of milk from the opposite side with a breast pump, and evacuation of the pus

It is probable that some early cases are aborted as a result of chemotherapy, support to the breast and such local applications as antiphlogistine or hot com presses of magnesium sulphate In any case the scalpel should be withheld until there is some evidence of localisation In a buxom breast the presence of pus is indicated by localised tenderness induration of the breast and œdema of the overlying skin The advent of fluctuation must not be awaited although this may be an early sign if the abscess is near the surface

When the presence of pus is suspected an anæsthetic is administered and pentothal is ideal A free incision radiating from the nipple is made over the site of the abscess and is so situated as to secure dependent drainage A finger is introduced, all pockets and loculi being thrown into one cavity When all the pus has been evacuated a large rubber drainage tube is secured in position by a silkworm gut suture, and the wound closed around the tube Through the large tube a smaller one is inserted so as to form a "two way" tube (Fig 84) The skin is covered with vaseline-smeared lint as a protective gauze or fluffed wool is applied and the dressings kept in place with a many tailed bandage This method allows irrigation of the cavity with eusol about 4 ounces being syringed through the small tube every 4 or 6 hours The dressing requires changing only once or twice each 24 hours This closed method of drainage is labour-saving and the patient is not disturbed by frequent dressings The risk of secon dary infection is minimised, and cases heal more quickly than if treated by open drainage The tubes

are shortened after 3 or 4 days, and can usually be removed after a week

The preceding remarks concerning the treatment of *intramammary abscess* apply in the case of the *submammary* type excepting that this may sometimes be treated by an infero-lateral incision in the thoracomammary groove

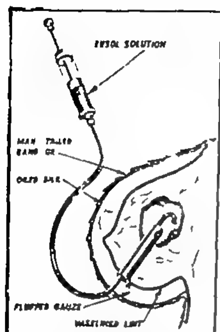


FIG 34 —The "Closed method of treating a breast abscess. Eusol is injected along the small tube every 4 hours. The overflow runs out of the large tube and is absorbed by the gauze. The layer of vaselined gauze protects the skin from the irritating effect of the fluid

In the case of *supra mammary* suppuration an incision is necessary but the direction is immaterial as the pus is superficial to the breast tissue Sometimes a supramammary abscess is the superficial part of an hourglass-shaped abscess, the deep portion of which forms an intramammary abscess This possibility must always be borne in mind and careful search made for any deep communication

Alveolar Abscess—An alveolar abscess usually results from a carious tooth infection spreading from the pulp chamber through the foramen at the apex of the fang Pus forms and may escape between the alveolus and tooth perforate the inner or outer table or pass downwards into the body of the jaw The typical alveolar abscess forms beneath the external periosteum of the alveolus the pus having pierced the thinner outer table or passed

over its edge Pain œdema of the face and swelling are generally well marked, constitutional disturbance is variable and may be severe, whilst trismus sometimes prevents the patient from separating his teeth for more than half an inch Fluctuation is usually obtainable inside the mouth over the alveolus outside the mouth or both

Treatment —It is essential to evacuate the pus in order to relieve the condition and prevent the abscess from bursting externally and it is also necessary to treat the cause Usually this will mean extraction of the tooth, which in many cases is all that is required Sometimes however the abscess does not appear to drain well and may be pointing inside the mouth at some little distance from the tooth, in which case it should be freely opened When the abscess is pointing externally and is almost through the skin an external excision is unavoidable

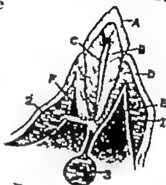


Fig 35 —Alveolar abscess

a = enamel.
b = dentine
c = pulp cavity
d = gum.
e = inner table of alveolus.
= thinner outer table of alveolus.
1 = alveolar abscess formed under the periosteum on the inner side of the alveolar process the pus having passed from around the fang up between the teeth and inner table over the edge of the latter.
2 = external alveolar abscess, in which the pus has pierced the outer table.
3 = infection spreading downwards from the tooth into the jaw producing an abscess therein.

If the condition is not very urgent and there is a possibility of saving the tooth, especially if this is an incisor or canine the abscess should be well opened and the patient transferred to a dental surgeon

N B —Alveolar abscesses should not be fomented as the liability for them to point externally is increased Warm mouth washes should be prescribed

Chronic Abscesses in the great majority of cases are tuberculous in origin but a few are due to the organisms previously mentioned in connection with acute

abscess The essential difference between them is that tuberculous abscesses have a lining membrane containing giant-celled systems and tubercle bacilli, whilst the "pyogenic" have no such membrane being merely surrounded by granulation or fibrous tissue It is therefore obvious that in the former, radical treatment should include removal of the lining membrane, whereas in the latter a simple incision is usually all that is required

The Treatment of a Tuberculous Abscess.—The usual *general* treatment of tuberculosis is carried out and includes fresh air sunshine or heliotherapy, plenty of good food, cod liver oil and malt combined with tuberculin injections, if considered advisable

Locally the primary condition must, of course, receive attention, e g if the abscess is secondary to tuberculous arthritis of the knee joint, the joint must be moved from the position of greatest ease to that of maximum utility for ankylosis, immobilised in that position by a suitable splint or plaster and inter osseous pressure avoided The abscess itself is treated as follows

1 It is ignored and if the initial cause yields to treatment absorption will occur If the abscess enlarges in size so that rupture and consequent secondary infection are threatened, or if it is submucous as in the case of a retropharyngeal abscess then aspiration or evacuation is necessary The injection of iodoform emulsion may be combined with the aspiration which can be repeated from time to time as may be necessary

2 It is incised the contents evacuated all tuberculous granulation tissue gently removed with the sharp spoon and any underlying condition such as a piece of dead bone or glandular debris beneath the deep fascia, dealt with Hæmostasis is effected a little B I P is rubbed in lightly and the wound sutured a large dressing being applied firmly If

the skin overlying the abscess is involved, the affected part may be removed, and if suturing is then impossible the resulting wound is packed with vaselined gauze and covered with an elastoplast bandage Tuberculous abscesses should not be allowed to reach this stage

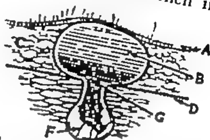


Fig 36.—Collar-stud abscess.
a = skin.
b = pus in superficial portion of abscess.
c = subcutaneous tissue in which lies the superficial half of the abscess.
d = the deep fascia.
g = hole in deep fascia.
f = glandular debris which may be partly calcified.

3 Some abscesses are treated by evacuation and removal of the underlying cause such as a tuberculous gland or part of a rib The wound is either closed or drained for twenty four hours if oozing renders drainage advisable

Carbuncle

A carbuncle is due to gangrene of the subcutaneous tissues It is predisposed to by diabetes debility and alcoholism General treatment is directed to combating any predisposing cause, and an adequate course of chemotherapy in order to combat infection Penicillin may be advisable if the causative organisms are sensitive Sedatives are necessary in order to relieve pain and to provide sleep

In the early stages local treatment is directed to promoting hyperæmia. Fomentations are inadvisable in that they encourage infection of adjacent hair follicles Hypertonic saline or a 12 per cent aqueous solution of sodium sulphate is useful in the early stages and if the surrounding skin is protected by some antiseptic preparation, such as ung hyd. nit. dil. auto-inoculation will be discouraged Some surgeons endeavour to prevent extension of a carbuncle

by injecting blood around the periphery Gas and oxygen or pentothal are administered, and 20 c c of blood is withdrawn from the patient into a syringe containing 2 c c of 2 per cent sodium citrate The blood is injected at various points each injection commencing in the subcutaneous tissue and terminating in the necrotic area In order to prevent auto *infection a clean needle should be used for each* injection In some cases X ray therapy relieves discomfort and appears to limit spread of infection

When suppuration has occurred ichthyol (10 per cent) in glycerine or Morison's paste (glycerine 11 parts, desiccated magnesium sulphate 30 parts) are among the best preparations for the promotion of healing

In some cases when induration is pronounced and *pain severe excision of the affected area, under anæs*thesia, with a cautery or diathermy knife, gives profound relief and probably limits extension The resulting cavity is packed with vaseline gauze or flavine emulsion

Carbuncles of the face and upper lip are extremely dangerous as thrombosis of veins may extend to the cavernous sinus The patient must be confined to bed and provided with a bowl *of hot hypertonic* saline so that he can almost continually bathe the affected area Chemotherapy or penicillin is prescribed and every attention is paid to his general health

As in the case of infected wounds squeezing is strongly to be deprecated, and the patient should be warned against this common practice. Squeezing may express some pus (which will in any case discharge in due course) but it traumatises adjacent tissues and encourages extension of infection along interstitial planes

ceding by ½ to ⅔ (Fig 37) If the circumference of the part is not uniform throughout, the bandage will require to be reversed

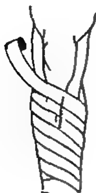


Fig 37 —Simple spiral bandage.



Fig 38.—The reverse bandage

2 *The Reverse* —This consists in turning over the bandage as in the diagram (Fig 38) whilst the thumb of the other hand keeps the upper border of the spiral bandage in the correct position After the reverse has been made, the bandage is carried round the limb and another reverse made higher up and in the same line as the first The reverses should lie on the antero-lateral aspect of the limb and be continued as long as the changing calibre of the limb necessitates



Fig 39.—Figure of eight to knee seen from behind.

3 *The Figure of Eight* —This is an excellent method for bandaging joints but can also be used for those parts in which a reversed bandage is indicated It consists of a number of loops applied to the part in the form of a figure of eight the loops being well open A turn or two is made with the bandage below the joint after which it crosses the flexor aspect of the latter and is made to encircle the limb above it this process being repeated as required

4 *The spica* —This is a figure of eight in which the loop round the proximal part is bigger than that round the distal part It is chiefly used for bandaging the shoulder, groin, thumb and toe ("Spica" is a Latin word meaning an ear of corn The individual grains alternate on the ear in a manner which resembles the pattern where the turns of the bandage cross each other)

Head Bandages

1 *The triangular* —The bandage is laid on the head, so that the base lies along the forehead and the apex hangs down over the back of the neck The two ends of the base are drawn back tightly round the sides of the head, cross below the external occipital protuberance superficial to the apex, and pass forwards round the sides of the head to be tied in front on the fore head The apex is now pulled upwards and fixed in position by a safety pin

2 *Capeline* —This is a double headed bandage which can also be applied to an amputation stump Two bandages are tied together and the surgeon places the knot below the occiput He then passes the two heads around the sides of the cranium making them cross below the forehead, then carrying the lower head upwards and forwards in the middle line whilst the upper head is continued round to the occiput where it binds down the other head which is now carried backwards to below the forehead there being fixed again by the encircling bandage By these means the whole or part of the head can be covered



Fig 40 —Capeline bandages.

3 The *recurrent* bandage for stumps (page 125) may also be used for the head, but the ends of the revers

must come well down below the occipital protuberance and forehead

4 The T *bandage*, described under Perineum, is very useful for the head, the horizontal limb of the T passing round the forehead and below the occiput, whilst the vertical limb or limbs pass over the scalp

5 The 4 *tailed bandage* is described under Fractured Jaw

Spica of Shoulder—The bandage is applied round the upper arm from within outwards, until the axilla is reached, the bandage then passing forwards beneath the axilla, upwards over the anterior fold and shoulder, then round the back of the chest beneath the opposite axilla across the front of the chest

Spica of Thumb—Two or three turns of bandage are applied round the wrist, after which the bandage is passed round the thumb as high as possible, then round the wrist, then the thumb until the part is covered

Figure of Eight for the Elbow-Joint.—The joint is put in the position in which it will be maintained after bandaging, and the bandage is applied to the point of the elbow, one or two turns being made Gradually increasing loops of a figure-of-eight bandage are now applied round the arm and forearm, the site of crossing being in front of the joint

Spica of Groin—The application of this bandage is rendered much easier by the employment of a pelvic rest, which is placed transversely beneath the sacrum Two or three turns are taken round the upper part of the thigh (which is a little flexed and abducted) from within outwards with reverses if necessary after which the bandage is carried outwards along the groin round the back of the false pelvis, across the pubes to reach the upper part of the thigh around which a turn is

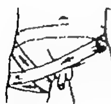


FIG 41—Ascending spica of groin

taken followed by another round the body Each succeeding turn is a little higher than the preceding one It is important to keep the bandage below the level of the iliac crest

The leg and thigh are bandaged by a combined spiral and reverse, whilst the knee and heel may be conveniently covered by a figure of eight, as described for the elbow joint

If it is necessary to bandage the whole of the lower extremity a simple spiral could be applied to the foot with reverses on the dorsum when necessary it would include the ankle and heel by changing to a figure of eight would cover the lower part of the leg as a simple spiral, the calf as a reversed the knee as a figure of eight, the lower thigh as a spiral, the upper thigh as a reversed and the hip as a spica

Recurrent Bandage for Stumps—Two turns of bandage are applied firmly to the stump The bandage is then carried backwards and forwards over the end of the stump the reverses being held in position by the finger and thumb of the other hand When the stump is covered the reverses are fixed in position by several turns of the bandage round the stump

The recurrent method may be conveniently employed during the bandaging of a finger or big toe to cover the end

The Perineum.—Dressings are generally kept on the perineum by a double T bandage of which the horizontal limb is applied round the waist and the vertical passes downwards and forwards over the perineum splits to avoid the scrotum and penis in the male the two ends being tied or pinned to the pelvic band

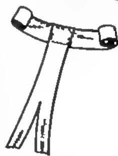


FIG 42.—Perineal T bandage

The Breast Bandage—Two turns of bandage are passed round the chest below and away from the affected breast after which it passes up

wards in front of the breast over the opposite shoulder, across the back to the starting point, then round the chest, the turns being repeated until the breast is covered



Fig 43.—Breast bandage

Both breasts can be covered by a simple modification of this bandage This consists in passing the bandage round the chest, then over one breast the opposite shoulder, round the back of the neck, over the front of the chest across the uncovered breast

Another useful method is a bandage which passes round the chest and then crosses one breast above the nipple, round the back, the opposite breast above the nipple the first breast below the nipple, round the back, the second breast below the nipple, and so on

Many-tailed Bandage—This is particularly useful for abdominal work, and the best pattern consists of a longitudinal piece of flannel to the side of which are sewn pieces of flannel in such a way that when applied round the abdomen or limb, the one above overlaps the one below and pieces of opposite sides overlap each other to the extent of half the circumference of the part It is applied so that the tails overlap from below upwards

Unna's Bandage.—This method was formerly the standby in the treatment of varicose ulcers and is still useful if the patient s skin is intolerant of plaster The limb is cleansed and dried a bandage is applied after which Unna s paste melted by heating in a water bath, is rubbed in another bandage applied and more paste rubbed in It forms a firm but light support for the leg and if the ulcer requires frequent dressing a window may be made by cutting away the bandage from over the ulcer The bandage usually requires changing fortnightly Unna s paste consists of a mixture of gelatin 5 parts zinc oxide 5 parts glycerine 8 parts water 6 parts, boric acid 1 part.

This method has been superseded to a great extent by the use of an adhesive, elastic bandage

SLINGS

1 **The Triangular Sling**—A triangular bandage is placed in such a position that the right angle is in the axilla of the affected side and one end of the base (hypotenuse) lies over the opposite shoulder. The forearm is now placed across the chest so that the wrist is at a higher level than the elbow in order to encourage venous drainage. The inferior angle of the triangle is lifted up over the forearm and shoulder of the affected side and tied to the other end of the base. The right angled end is now brought forwards and pinned over the front of the forearm.



FIG 44—Triangular sling.

The forearm may also be slung by a piece of bandage which is fixed to the limb by a clove hitch or it can be suspended by pinning the sleeve to the lapel of the coat.

2 **Collar and Cuff Sling**—This very useful sling consists of a collar, preferably made of leather, to which is attached a vertical strap which is itself attached to the cuff. The vertical strap is adjustable so that the elbow can be flexed to almost any extent and the position changed from day to day if required. It is extremely useful in the after treatment of fractures round the elbow joint (see Supracondylar Fractures).

KNOTS

The *reef knot* is the one most widely used by surgeons and generally speaking meets all ordinary requirements. A granny knot should never be used.

When it is necessary temporarily to tie a knot which on pulling never slips but gets tighter, although it can always be readily loosened, the *clove hitch* should be used.

The *surgeon s knot* is very useful when a ligature is being tied at the bottom of a deep wound or if a suture under tension is being tied

A *Staffordshire knot* is especially indicated for

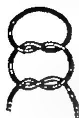


FIG 45 Reef knot



FIG 46 Granny knot



FIG 47—To complete the clove hitch the second loop is passed in front of the first.



FIG 48.—The surgeon s knot.



FIG 49—First stage of Staffordshire knot



FIG 50—Third stage merely consists in tying together *a* and *b*.

ligating vascular pedicles A double threaded pedicle needle is made to transfix the pedicle the needle being withdrawn and the loop passed over the stump One end of the ligature is slipped through the loop tightened and the two ends then tied

remain ambulatory is by means of elastoplast or similar adhesive bandages

Boils commonly abort if covered with two or three layers of elastoplast in the early stages, and strapping is a useful adjunct in the treatment of carbuncles

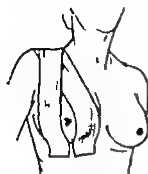


Fig 53.—Strapping applied to support the breast

Bedsores in the early stages, should be protected by a double layer of elastoplast applied without stretching The plaster is untouched until loosened by discharge, which may be from one to several days The sore is then gently swabbed with a mild antiseptic and the plaster reapplied By this means granulations are undamaged by frequent dressings, and possibly the retained pus possesses a proteolytic property which liquefies dead tissue

Warts commonly disappear if covered by strapping The strapping is removed weekly, and the macerated horny epithelium removed by scraping The majority of cases are cured after 1 to [illegible] weeks' treatment

Approximation of Wounds —Wounds can be approximated by cutting a hole in one piece of elastoplast, and threading a narrower piece through the aperture This resembles the old fashioned hare lip plaster, and is also useful for the approximation of small, clean cuts



Fig 54.—Correction of early talipes by means of strapping

Deformities, such as hallux valgus and early talipes, after correction can be maintained in position by the appropriate application of strapping

Medicated Plasters —Some plasters are medicated for anodyne (belladonna) counter irritation and other purposes When however counter irritation and pressure are required perhaps the best method consists in strapping applied over strips of lint on which is spread Scott's dressing (ung hydrarg co)

CHAPTER VIII

HERNIA

Non-operative Treatment

There are two essential factors in the causation of hernia the first being weakness either congenital or acquired of the abdominal wall, and the second, increased intra-abdominal pressure The first is treated by operation or relieved by the wearing of a truss the second by treating the cause

Increase of intra-abdominal pressure results from abdominal distension associated with rickets straining at micturition owing to a stricture or an enlarged prostate straining to defæcate following constipation or a rectal polyp bronchitis, and many other causes It is of the greatest importance to determine the particular cause or causes and to treat them appropriately

Inguinal hernia is the commonest type to appear in children It is best treated by the wearing of a rubber truss which is of practically the same shape as the steel spring inguinal truss, to be described later It is worn day and night, and the patient should possess two so that when one is being cleaned the other can be used A truss is kept on during bathing and it is essential that the hernia is never allowed to "come down." When the truss is being changed a finger or thumb is applied to the inguinal canal

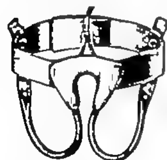


Fig 55 —Horse-shoe truss.

Another useful truss for babies is the *horse shoe* It is made of rubber and has a horseshoe-shaped

inflatable pad, held in position by rubber pelvic and perineal bands It is particularly indicated for double inguinal herniæ

If a hernia continues to descend after the end of the second year operative treatment should be advised If a hernia has not appeared for one year, the truss can be discarded

The life of a rubber truss is about 6 months but will be considerably shorter if ointment and greasy substances are allowed to soil it

Unless some very definite contraindication exists herniæ occurring from the age of two years to adult

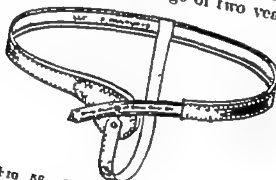


FIG 56.—Steel-spring inguinal truss.

life are treated by operation Trusses are unsuitable for children and adolescents also growth of the patient necessitates constant refitting

For adults the best form of truss is *a steel spring* which passes round the body between the trochanter and the iliac crest and presses a pad against the site of hernial protrusion The spring reaches as far forward as the opposite anterior superior iliac spine and is then continued on as a strap which is fastened to the upper small stud on the pad The latter is usually made of horse hair and covered with leather or rubber but may be vulcanite wood or filled with fluid Attached to the truss on the affected side is a perineal band, which passes round the back of

the thigh to the inner side and thence to the lower of the two studs on the pad It should prevent the latter from slipping upwards, but should not be tight enough to inconvenience the patient Both the internal ring and the inguinal canal are covered by the pad, which will almost reach, but not press upon, the pubic bone

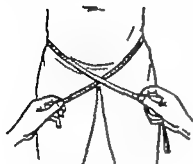


Fig 57 —Method of measuring patient for truss.

When ordering a truss, the surgeon should measure closely round the pelvis, midway between the iliac crest and the great trochanter, and should inform the instrument maker as to whether the hernia is inguinal or femoral, right or left, bubonocele or scrotal, direct or indirect, its size and the patient's age and occupation If possible it is more satisfactory for the instrument maker himself to measure and fit the patient.

A useful test for deciding if a truss is efficient is to ask the patient to sit on the edge of a chair, with his legs apart and extended, and to cough vigorously If the hernia does not escape under these conditions, it is obviously well supported

Rat tailed truss (scrotal truss) —When a rupture (usually scrotal) cannot be kept up by the simple spring truss, the pad is continued downwards in the form of a tail, which is continuous with the perineal band This is usually successful, but not always the rupture sometimes escaping from the inner side of the pad in which case a *forked tongue truss* may be necessary It consists of a rat tailed truss of which the pad is extended across the middle line and fastened to the spring

Hinged-cup truss (Fig 58) —This is a special truss for the treatment of a large irreducible scrotal hernia

downwards somewhat sharply, and the perineal strap is attached to the spring a little in front of the anterior superior iliac spine, more or less encircling the thigh The pad must be of the correct size and should not press on the pubic spine medially, nor the femoral vein laterally For a large hernia, the pad may with advantage be prolonged downwards and incorporated in a thigh piece

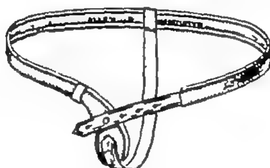


Fig 59 —Femoral steel-spring truss.

A truss for a femoral hernia is, however, less satisfactory than one for an inguinal hernia, for two reasons

1 During flexion of the thigh, as when seated the pad tends to be lifted off the sac, whereas in the inguinal type it is more closely apposed

2 A femoral sac is surrounded by condensed extraperitoneal fat (often erroneously termed a ' lipoma) This prevents compression of the sac also it is somewhat sensitive to pressure

It is generally agreed that a truss is not advisable for a femoral hernia, unless there *exists some definite* contraindication to operation

Umbilical Hernia.—*In children.*—The child should be placed on the back, and one end of a piece of strapping 1½ inches broad and 5 inches long is applied to the abdominal wall lateral to and a little below the umbilicus The hernia is reduced and a penny covered by two thicknesses of lint placed over the navel and

fixed in position by pulling on the piece of strapping and fixing it to the abdominal wall above and on the opposite side of the pad Another piece of strapping is applied over the pad almost at right angles to the first piece The strapping is changed every two weeks A rubber truss, consisting of a rubber pad and encircling rubber band, can also be used for children If the child attains the age of 2 years and the hernia is still present, operation should be advised

In older patients —A large pad is applied in front of and somewhat below the hernia and is fastened to a smaller pad over the spine by means of a steel spring and strap which encircle the body midway between the iliac and last rib The abdominal pad may be conveniently combined with an abdominal belt in fat patients with a sagging abdomen If irreducible as is commonly the case after middle age operation should be advised in order to forestall incarceration or strangulation



Fig 60 —Strapping an umbilical hernia in a child.

COMPLICATIONS OF A HERNIA

1 **Inflammation** —The hernia becomes red and painful but is not tense and no obstructive symptoms follow The patient is confined to bed fomentations are applied and the inflammation usually subsides

2 **Irreducibility** —Hernial contents may become adherent to the sac especially if inflammation has previously occurred Deposition of fat in the contents especially omentum sometimes prevents reduction Provided there are no contraindications all irreducible herniæ should be operated upon even if a prophylactic support is subsequently necessary as irreducibility is associated with the constant risk of strangulation

3 **Incarceration**—*This term implies interference with the onward passage of fæces, but the blood supply is unhampered* It is likely to occur if large bowel containing semi solid fæces is present in the sac, and therefore is most commonly a complication of umbilical herniæ, owing to the contained transverse colon The hernia is doughy in consistency, and a slight impulse on coughing is still felt If untreated it gradually passes into a condition of strangulation

Copious high enemata are given which, combined with massage of the hernia, result in alteration of the consistency of the fæces from putty to mud The *semi-solid mixture can then negotiate the neck of the sac*, and symptoms are relieved It must be remembered that incarceration merges into strangulation, and if doubt exists as to the exact condition operation is imperative

4 **Strangulation.**—*In this condition the blood supply of the hernial contents is obstructed, and gangrene follows if untreated* The hernia becomes tense, tender and impulse on coughing is lost

The essential treatment of strangulated hernia is to relieve the constriction as soon as possible and if necessary deal with the contents of the sac according to circumstance Two lines of treatment are taxis or operation

Taxis may be used in carefully selected cases and under certain conditions but the following contra indications must be remembered

1 *Previous Irreducibility*—In these cases the sac cannot be emptied and therefore there can be no guarantee without operation that the strangulation has been relieved

2 *Length of Time*—Convention has fixed an arbitrary time limit of 6 hours after which taxis should not be attempted owing to risk of gangrene It must be emphasised however that small herniæ which are tightly nipped by the constricting agent

may become gangrenous in four hours, whereas the contents of a large hernia with a wide neck can retain their vitality for much longer than six hours

II *Type of Hernia* —Most surgeons consider that femoral herniæ should never be subjected to taxis, as owing to the comparatively tortuous path of the sac (downwards forwards, and upwards), taxis is only a misnomer for ill-directed pressure

In cases of strangulated umbilical herniæ irreducibility is usually present and hence taxis is inadvisable Therefore for practical purposes, taxis is only suitable for inguinal herniæ, provided that the strangulation is recent and the hernia previously reducible If taxis is safely and successfully performed, the following advantages are gained

(i) The case can be reviewed regarding subsequent treatment, i e truss or operation

(ii) If an operation is necessary, it can be performed when the patient is properly prepared

(iii) The time and place of the operation can be arranged so as to suit the convenience of all concerned

TAXIS AS APPLIED TO AN INGUINAL HERNIA —1 The head is raised and the thigh flexed to relax the abdominal muscles the leg should be rotated inwards to relax the external abdominal ring (Fig 61)

2 The contents of the sac which last escaped should be returned first, thus the neck is embraced and supported by the left thumb and fingers while steady pressure is applied to the fundus with the right hand.



FIG 61 —Applying taxis in the case of inguinal hernia. Note that the thigh is flexed and internally rotated.

Only moderate steady pressure must be used so that such calamities as "reduction en masse" or rupture of the bowel are impossible However, reduction into an interstitial loculus is a possibility even when taxis is applied correctly, in which case symptoms persist although the swelling has disappeared

If taxis attempted on these lines is unsuccessful then preparations should be made for operation, and meanwhile the patient is put to bed with the foot of the bed raised, morphia is given, and a linseed meal poultice or ice bag applied A very useful method to encourage return of gut in children consists in tying the legs to a framework over the bed so that the buttocks are raised off the bed

When preparations for operation are completed, it is frequently found that reduction has occurred spontaneously If however such is not the case and the hernia is still within the time limit of safety taxis is again attempted and often successfully If taxis still fails an anæsthetic is given and in exceptional circumstances taxis may again be applied, this should only be done if there is a definite contraindication to operation This contraindication may be on general grounds, such as diabetes tabes or environment or with special reference to the hernia e g chronic bronchitis or very large hernial orifices, when recurrence is probable In other cases operation is performed so that the contents of the sac may be scrutinised and the radical cure of the hernia attempted

Although taxis applied under the above principles is reasonably safe, yet the modern tendency which is strongly recommended is to operate immediately in all cases provided adequate facilities are available and the condition of the patient is suitable

Operative Treatment of Hernia

Inguinal Hernia

If operative treatment is advisable an incision is made half an inch above and parallel to Poupart's ligament from the internal abdominal ring to above the pubic spine The skin and fasciæ are divided including the superficial epigastric, and usually the superficial external pudic arteries The external oblique aponeurosis is split in the line of the fibres and the intercolumnar fibres divided exposing the spermatic cord lying in the inguinal canal The cord is raised from its bed and the sac identified by its whitish colour It is separated from the cord opened, and any contents freed and returned to the abdomen unless omentum is present and has numerous adherent fringes in which case it is often easier to ligate and divide the omentum at the neck of the sac If the sac is empty a probe must be passed through the neck into the abdominal cavity in order to distinguish it from a loculus The sac is then separated up to its neck, which is recognised by the encircling collar of yellow extraperitoneal fat also in old-standing cases a constriction exists at this point The neck is transfixed with chromic catgut and the sac removed The internal oblique and conjoined tendon are now sutured to Poupart's ligament either in front of or behind the cord Floss silk is excellent for this purpose but if the muscles are in poor condition some surgeons prefer a fascial graft Sulphanilamide powder is dusted into the wound and the external oblique and skin are closed in layers

A firm spica bandage is applied, and the patient should remain in bed for 3 weeks and no vigorous work undertaken for 3 months During convalescence sea voyages are forbidden as vomiting is particularly dangerous

Strangulated Inguinal Hernia

The sac having been exposed and opened, it is slit up to the neck. In adults the constricting agent is the thickened neck of the sac. A hernia director is passed through the sac, which is divided in an upward and inward direction, so that, whether the hernia is direct or indirect the incision is parallel to the deep epigastric artery Contents of the sac are withdrawn and treated according to circumstances Thus, if viability is assured the bowel is returned Should small intestine be gangrenous resection and anastomosis is usually performed, but if large gut is gangrenous resection and drainage of both ends by means of a Paul s tube is essential The continuity of the bowel is restored when the patient has recovered from the obstruction The sac is removed and radical cure completed as described In children the constriction is sometimes caused by the pillars of the external abdominal ring which are relaxed when the inter columnar fibres are divided

Femoral Hernia

Differential Diagnosis

(i) *Inguinal Hernia.*—The neck of the femoral hernia lies below and to the outer side of the pubic spine whereas that of an inguinal hernia is above and internal to that prominence If a large femoral hernia has turned up in front of Poupart s ligament distinction may be difficult

(ii) *Psoas Abscess* —This yields an impulse on coughing, but the abscess can also be palpated above Poupart s ligament, and other signs of tuberculosis of the spine are present

(iii) *Saphenous Varix* —On coughing a thrill can be detected, as distinct from an impulse Other varicosities are usually present

(iv) *Other Swellings* —An enlarged gland a lipoma,

an enlarged psoas bursa, etc may resemble a femoral hernia but characteristic features usually serve to diagnose the condition

Operation.—In uncomplicated cases the method advocated by Lockwood is satisfactory A vertical incision may be made over the swelling but an oblique one superimposed over Poupart's ligament gives similar exposure, heals more readily and lies in a natural crease The fasciæ covering the sac are divided and the sac is opened The contents are dealt with and the sac freed to the neck, which is transfixed and ligated The canal is obliterated by suturing Poupart's ligament to the fascia over the pectineus muscle Care must be taken that undue pressure is not exerted on the common femoral vein, which might result in œdema of the leg

Strangulated Femoral Hernia

The operation must be planned so that exposure of the hernia is adequate and access may be gained to the peritoneal cavity in case resection or drainage of gut is necessary which procedures cannot be satisfactorily performed below Poupart's ligament An incision is made over the inner half of Poupart's ligament and the skin and fasciæ are retracted downwards to expose the sac This is opened and cleared up to the neck. The constricting agent is Gimbernat's ligament which is divided by passing a hernia director without the sac on its inner aspect, i.e between the neck of the sac and Gimbernat's ligament Two or three nicks are made in the ligament or in many cases the outer part can be avulsed from its attachment by firm digital pressure after which the contents of the sac can be readily withdrawn If suitable for return hernial contents are reduced, and sac is transfixed ligated and removed radical cure being achieved by suturing Poupart's

Strangulated Inguinal Hernia

The sac having been exposed and opened, it is slit up to the neck. In adults the constricting agent is the thickened neck of the sac. A hernia director is *passed through the sac, which is divided in an* upward and inward direction, so that whether the hernia is direct or indirect the incision is parallel to the deep epigastric artery Contents of the sac are withdrawn and treated according to circumstances Thus if viability is assured the bowel is returned Should small intestine be gangrenous resection and anastomosis is usually performed but if large gut is gangrenous resection and drainage of both ends by means of a Paul s tube is essential The continuity of the bowel is restored when the patient has recovered from the obstruction The sac is removed and radical cure completed as described In children the constriction is sometimes caused by the pillars of the external abdominal ring which are relaxed when the inter columnar fibres are divided

Femoral Hernia

Differential Diagnosis

(i) *Inguinal Hernia* —The neck of the femoral hernia lies below and to the outer side of the pubic spine whereas that of an inguinal hernia is above and internal to that prominence If a large femoral hernia has turned up in front of Poupart s ligament dis tinction may be difficult

(ii) *Psoas Abscess* —This yields an impulse on coughing, but the abscess can also be palpated above Poupart s ligament and other signs of tuberculosis of the spine are present

(iii) *Saphenous Varix.*—On coughing a thrill can be detected as distinct from an impulse Other varicosities are usually present

(iv) *Other Swellings* —An enlarged gland, a lipoma,

an enlarged psoas bursa, etc, may resemble a femoral hernia but characteristic features usually serve to diagnose the condition

Operation—In uncomplicated cases the method advocated by Lockwood is satisfactory A vertical incision may be made over the swelling, but an oblique one superimposed over Poupart's ligament gives similar exposure, heals more readily, and lies in a natural crease The fasciæ covering the sac are divided and the sac is opened The contents are dealt with and the sac freed to the neck which is transfixed and ligated The canal is obliterated by suturing Poupart's ligament to the fascia over the pectineus muscle Care must be taken that undue pressure is not exerted on the common femoral vein, which might result in œdema of the leg

Strangulated Femoral Hernia

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ligament to the fascia over the pectineus, as already described (Lockwood)

If gangrenous bowel is present, so that resection or drainage of bowel is necessary the method advocated by Lotheisen is advisable The gangrenous loop of bowel is wrapped in gauze and left on the groin The skin is then retracted upwards and the external oblique divided, exposing the inguinal canal The arching fibres of the internal oblique and conjoined tendon are retracted upwards and the transversalis fascia and peritoneum divided above Poupart's ligament The peritoneal cavity is carefully packed off and the gangrenous loop is gently withdrawn along the crural canal and brought out on the abdominal wall. Drainage or anastomosis is performed as required Forceps are then passed from above under Poupart's ligament, the fundus of the sac is grasped and the sac withdrawn along the crural canal, brought out above Poupart's ligament and ligated The incision through the peritoneum is closed and radical cure achieved by suturing the conjoined tendon to Cooper s ligament i e the fascia covering the pectineus muscle at its origin form the ilio pectineal line The *aponeurosis of the external oblique* is sutured and the wound closed

Umbilical Hernia

Operation is performed by Mayo s method, the surrounding skin and fat being excised through a transverse elliptical incision The sac is opened at the neck, the contents are removed and returned, and radical cure performed as described in connection with strangulated umbilical hernia

Strangulated Umbilical Hernia

A transverse elliptical incision is made above and below the sac, of sufficient length to allow subsequent

suture without tension, tissue forceps are applied to the fundus of the enclosed mass in order to steady it and allow traction in required directions The incision is deepened until the rectus aponeurosis is reached, when subcutaneous fat is dissected up from the aponeurosis to the neck of the sac (Fig 62) The sac is drawn upwards and the lower half of the neck of the sac is then divided and extended by a short incision through the linea alba and the peritoneum on either side The upper half of the neck of the sac is now utilised as a hinge, so that the sac is everted and drawn

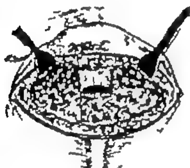


Fig 62.

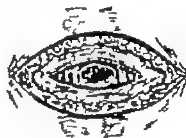


Fig 63.

upwards over the contents, this exposes the strangulated structures at the neck of the sac, which are then examined and dealt with as is most expedient The sac, with the ellipse of skin and subcutaneous tissue, is then removed (Fig 63) The peritoneum is adherent to the back of the rectus sheath, and the elliptical gap is closed by the method suggested by Mayo Mattress sutures are introduced to draw the upper portion of rectus aponeurosis and peritoneum underneath the lower (Fig 64) The free upper border is then stitched down to the linea alba by interrupted chromic catgut sutures (Fig 65) Sulphonamide powder is applied and the skin and subcutaneous fat are approximated by deep silkworm or nylon sutures

A drain is inserted down to the rectus aponeurosis at either end of the wound, in order to allow escape of exudates should infection occur



Fig 64.

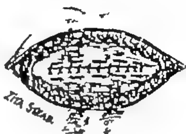


Fig 65

Interstitial Herniæ are associated with an undescended testicle in over 50 per cent. of cases The presence of this type of herniæ may account for continuance of symptoms after apparently successful taxis in a case of strangulated inguinal hernia owing to bowel being displaced into the interstitial loculus. As these herniæ cannot be controlled satisfactorily by means of a truss they should be subjected to operation.

CHAPTER IX

MINOR SURGICAL OPERATIONS

By R. E. Norrish, F.R.C.S.

Blood Transfusion

Blood transfusion has in recent years become a routine therapeutic proceeding in both medicine and surgery; it is sometimes accessory to other treatment and is often demanded as a life-saving measure. It has, however, certain dangers, and should always be used with discrimination and care. The operation has a definite mortality, and in its performance the same scrupulous asepsis must be studied as is accorded to all surgical procedures, whether major or minor.

Indications

In the treatment of dangerous hæmorrhage blood transfusion is a logical measure, often attended by remarkable success: a blanched and pulseless patient may in a few minutes revive, and by this means is snatched from the dead. Sometimes, as in rupture of an ectopic gestation, the source of hæmorrhage can be controlled, transfusion merely replacing that which has been lost from the circulation. At other times, as in hæmorrhage from a peptic ulcer, transfusion has a definite hæmostatic action, the result of a fresh supply of coagulating agents which are thus introduced. There is little danger of increasing the bleeding by this means provided the rate of transfusion is controlled. When the hæmoglobin has fallen to 40 per cent. in acute or chronic

hæmorrhage, life is endangered and transfusion must be carried out

(5) In the treatment of shock, if associated with bleeding timely restoration of the blood volume is of vital importance Of recent years the value of transfusion with blood or an allied substance has been increasingly appreciated and its use is discussed on page 157

(6) When anæmia is present particularly if it is due to small but repeated hæmorrhages, to chronic infection or to neoplasm, blood transfusion is of great value and should always precede or accompany serious surgical operation especially when the chances of hæmorrhage are considerable When given during an operation it may allow the completion of a long or difficult procedure which would not otherwise be possible Post operatively it may successfully combat dangerous shock following loss of blood and surgical manipulation

(7) In severe infection, as in acute osteo-myelitis or in septicæmia, transfusion of blood by the dilution of toxins the combating of anæmia, and the introduction of antibodies may be of especial benefit as a subsidiary treatment. *Such transfusions are of relatively* small amounts, 50–100 c c. and can be repeated several times

Contraindications

The intravenous administration of blood is attended with danger if used indiscriminately As with such infusion generally it must be avoided where congestion of the venous side of the circulation is in evidence, and where the right side of the heart is embarrassed Thus it is contraindicated when pneumonia, bronchitis, and allied pulmonary conditions are present, also transfusion may not be performed where renal disease is evident, and especially when uræmia is threatened In such cases, any added strain on the

kidney by the most minor degree of incompatibility may be fatal

Preliminary Requirements

Certain preliminary conditions must be fulfilled The donor must be free from serious communicable disease Thus syphilis tuberculosis, and malaria are excluded by careful investigation of the prospective donor, who should be in sound general health

His blood must be proved to be compatible serologically with that of the recipient The addition of incompatible blood results in the adherence together of the added corpuscles in clumps and masses (agglutination), whose presence in the circulation of the recipient is productive of embolism of the smaller blood vessels with especial damage to those of the kidney Thus hæmoglobinuria petechial cutaneous hæmorrhages and bleeding from the bowel may be accompanied by rigor from the presence of foreign material in the blood stream and uræmia is apt to follow In addition hæmolysis of the introduced corpuscles may be associated with severe or even fatal jaundice

Blood Grouping.—There are four main groups, as indicated in the Moss classification (until recently in general use in this country) They are Groups 1, 2 3 and 4 At the present time the International Classification describes these as AB A, B and O Of these Group O is most frequently met with, Group A is next Group B is uncommon and Group AB is rare The corpuscles of an individual of Group O are miscible with the blood serum of a recipient of any of the groups without agglutination and such is a universal donor The blood serum of a recipient of Group AB can receive the blood of a donor of any of the groups without the corpuscles of the latter being agglutinated and such is a universal recipient The corpuscles of a donor of Group A can be received by a

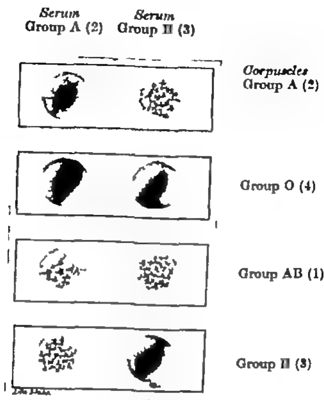


FIG 60.—Blood grouping

recipient of Groups AB and A but not one of Groups B and O those of a donor of Group B can be received by a recipient of Groups AB or B but not one of Groups A or O

Compatibility between the donor's corpuscles and the recipient's serum is usually all that is required In cases of severe anæmia, where the volume of the transfused blood will form a significant proportion of the recipient's blood volume it is desirable for the donor's serum to be compatible with the recipient's corpuscles as well as vice versa, i e donor and recipient in such cases should belong to the same blood group

To ascertain the blood group of a given person a

drop of stock blood serum of Group A and another of Group B are placed side by side on a slide. A drop of blood from the ear obtained by prick from a sterile needle is added to each and after standing for five minutes is examined microscopically. If clumping of corpuscles is seen in the serum of Group A, then the corpuscles are those of an individual of Group B in the serum of Group B, then the corpuscles are from Group A. If clumping is present in both then the corpuscles are from Group AB, and if in neither they are from Group O.

Cross Matching.—Having grouped both donor and recipient, and proved that the former is in other respects suitable, it is wise before transfusion to test directly the miscibility of the two bloods together. Except in emergency, this should always be done, for certain sub-groups exist, so that minor degrees of incompatibility may be present, even within like groups. A few cubic centimetres of blood are removed from the patient and allowed to stand so that the clot will form and the serum separate. A drop of the latter is placed on a slide and tested directly with a drop of the blood of the donor, when no clumping should be seen.

Transfusion with incompatible blood is a serious accident and will lead to hæmolysis with the appearance of hæmatin in the urine. While alkaline hæmatin is soluble acid hæmatin is not, and it will be precipitated in the renal tubules thereby damaging the kidney. It is important therefore if hæmolysis occurs as the result of transfusion, to render the urine alkaline by immediate administration of citrates or bicarbonates in sufficient doses.

Rigors after blood transfusion sometimes occur even though the blood of the donor is wholly compatible with that of the recipient. The cause of these rigors is believed to be the presence of minute particles such as dead bacteria or other foreign material

These particles are called Pyrogens, and water can be freed of their presence by triple distillation It is of the greatest importance that all solutions of saline and citrate for intravenous use should be prepared with water which has just been trebly distilled and they should then be autoclaved immediately to prevent any chance of fresh contamination Similarly before sterilisation all tubing, needles, cannulæ, and containers should be well washed through to rid them of pyrogens

Taking Blood from the Donor—Direct transfusion from donor to recipient by way of a two-way syringe is no longer practised Instead, the donor is bled into a bottle containing sodium citrate, which prevents clotting The " blood bottles " of the Medical Research Council make very convenient receptacles and are in general use in this country Into such a bottle of 540 c c capacity is placed 100 c.c. of sterile 3 per cent sodium citrate in pyrogen free water It should be noted that the Medical Research Council bottle bears a mark at 180 c c., the amount of anticoagulant originally recommended, but this mark is no longer relevant as it is found a smaller amount suffices A small bore French a needle is attached by rubber tubing to a cork, as shown in Fig 68, and the whole apparatus is sterilised Before use it is carefully washed through with citrate solution, and the cork is fitted to the blood bottle The donor lies on a couch and a *sphygmomanometer is applied above his elbow* The pressure is maintained at about 80 mm so that veins are compressed without interference to arterial flow Thus venous congestion is produced which is increased by the donor clenching and unclenching his fist A preliminary intradermal wheal of 2 per cent procaine is made over the antecubital vein, and a

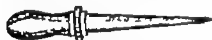


FIG 67 —French a needle.

minute nick in the skin is made with a scalpel The needle is now introduced into the vein and blood flows into the bottle, which is gently shaken the while When the blood reaches the 540 c c. mark, the pressure in the sphygmomanometer is released, the needle



Fig 68—Apparatus for taking blood

withdrawn and a firm pad applied over the elbow The donor should not be allowed to sit up for at least ten minutes lest faintness and syncope follow, and he should be given coffee as a stimulant before departing One bottleful of blood is the usual amount to be taken at a sitting but from a robust and willing donor two can safely be collected

Storage of Blood.—Blood taken as described into a screw topped Medical Research Council bottle may be stored at a temperature between 2° and 6° C for about three weeks it must on no account be allowed to freeze Adding 20 c c of sterile 15 per cent dextrose in pyrogen free water to the 100 c c of citrate solution in the bottle improves its keeping properties the dextrose solution must be autoclaved separately from the citrate solution The corpuscles in stored blood will be found to settle at the bottom of the bottle A tolerably distinct line of demarcation between this layer of corpuscles and the overlying slightly turbid layer of plasma indicates that hæmolysis has not occurred and that the blood is fit for use If the contents of the bottle are uniformly pigmented with hæmoglobin the corpuscles have hæmolysed, and the blood must be discarded Stored blood must be well shaken and warmed to body temperature before administration to a patient

Transfusion to the Recipient.—The apparatus shown in Fig 69 is both simple and convenient. It should previously have been sterilised and then well washed through with sterile citrate solution From an elevated upturned blood bottle the blood flows through a drip-feed bulb to a Luer Kaufman syringe, the rate of flow being controlled by a screw-clip A handful of sterile glass beads added to the bottle will collect at the neck, and provide a convenient filter for the blood With the glass plunger of the syringe withdrawn (as in Fig 69) blood is allowed to flow through the apparatus until it is filled when pushing home the plunger checks the flow Venepuncture is then performed, withdrawal of the plunger for the first few millimetres confirms its success by aspiration of blood from the vein while further withdrawal allows the flow from the side tube to recommence. An antecubital vein is usually chosen and the arm should be splinted during transfusion The syringe should be securely strapped in position with a swab tucked beneath it to maintain a suitable angle with the limb Any type of intravenous needle can be substituted for the syringe, but a little more dexterity will be required to enter the vein accurately and to avoid an air lock. When the bottle is exhausted another may be substituted the tube being compressed while the cork is transferred

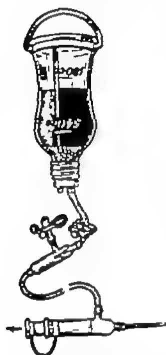


FIG 69—Apparatus for giving blood.

In children collapsed patients and others with veins unsuited for venepuncture, it will be necessary to expose a vein The same apparatus is used, but with a cannula in place of the syringe The internal saphenous vein, as it crosses the subcutaneous surface of the tibia just above the ankle is the most suitable Under local anæsthesia a one inch incision is made at right angles to its course, and a double ligature of cat gut is passed beneath the vein The distal ligature is tied, and held to steady the vein while a nick in which to insert the cannula is made with scissors The Hamilton Bailey cannula (Fig 70) has a shoulder

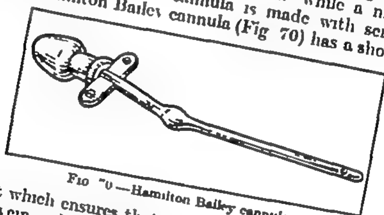


Fig 70—Hamilton Bailey cannula.

on it which ensures that the proximal ligature round the vein when tied retains the cannula in place Two apertures on the 'wings' enable it to be stitched to the skin for greater security

The usual rate at which blood is transfused is about 45 drops a minute This may be exceeded if it is desired to raise the blood pressure rapidly as in the presence of shock (*q.v*) but it must be remembered that increasing the volume of blood on the venous side throws an increased strain on the heart The transfusion should be stopped before the last few cubic centimetres of blood are emptied from the bottle in order that air does not enter the vein. The needle or cannula is withdrawn, and a firm dressing applied If the vein has been exposed through an incision a skin stitch will also be needed

SHOCK AND RESUSCITATION

Shock is a term that includes a variety of conditions still poorly differentiated It is used here to connote a condition following injury or operation characterised by *weakness, pallor, and raised pulse-rate* and in advanced cases by subnormal body temperature, sweating, low blood pressure, rapid thready pulse, vomiting and intense thirst. The constant pathological feature in shock is a *reduction in blood volume, which may be due to actual loss of blood (i e hæmorrhage)* or to loss of plasma which leaks out of the blood stream into the tissues, or to an increase of the capillary bed from splanchnic vaso-dilatation The reduced blood volume leads to general vasoconstriction *in an effort to maintain the level of the blood* pressure. Vasoconstriction means decreased tissue circulation, intensified if the blood pressure falls as well, and tissue anoxia. Prolonged anoxia produces permanent damage, and ultimately death

Treatment.—It cannot be emphasised too strongly that treatment of shock must begin early if possible "before its onset" By far the most important single need is the restoration of blood volume and thereby of tissue metabolism which is considered in the next paragraph The more important points concerning accessory therapy are as follows Morphia is given to relieve pain and restlessness *Warmth* is applied by means of hot water bottles, blankets or a radiant heat cradle Hot sweet drinks are of great value if swallowing is not contraindicated A few words of reassurance help to allay fear Any continuing hæmorrhage *is arrested, but further operation must be* postponed until the blood volume has been restored Raising the foot of the bed on blocks gives the vital centres of the brain as great a share as possible of the reduced tissue circulation Administration of oxygen

of plasma and serum, whether fluid or reconstituted from the dried product, appears to be much the same

The method of giving these fluids is the same as for blood (p 154) The glass bead filter is most important Enough fluid should be given to raise the blood pressure to above 100 mm of mercury, and to maintain it at that level. Three or four pints may succeed where one or two fail The first two pints can be administered rapidly if necessary under pressure, but after that a careful watch must be kept lest pulmonary œdema develop

Burns and crush injuries produce a type of shock characterised by a concentration of the blood in addition to a reduced blood volume Plasma or serum should be used in these conditions in preference to whole blood for the normal dilution is thus re established at the same time as the blood volume.

Operations on shocked patients should be postponed until the blood volume has been restored A blood pressure of over 100 mm of mercury is a reasonable criterion and the only exception should be to control hæmorrhage Gas and oxygen with ether if necessary is the best anæsthetic to use or failing this, open ether Local anæsthesia, where practicable is excellent Care must be taken that cyanosis is not allowed to develop Chloroform and spinal anæsthesia are contraindicated

Simple Dehydration

Simple dehydration arises when the fluid intake of the patient fails to balance the fluid output The normal intake by the mouth may be diminished because of difficulty in swallowing or if drinking is undesirable for therapeutic reasons as for example, after an operation on the stomach The fluid output is sometimes excessive on account of persistent vomiting or diarrhœa. Anæsthesia temporarily renders the heat regulating mechanism of the body

ineffective, and if it is prolonged there may be a considerable loss of fluid by surface evaporation more especially if abdominal viscera are extensively exposed at operation The adverse water balance occurs at the expense of the tissue fluids When the reserves of tissue fluid are exhausted, the normal blood volume can no longer be maintained and so shock supervenes (cf p 156)

The minimum fluid intake of a normal adult is about 3 pints a day If a patient is unable to take this amount by mouth, or if his fluid output exceeds the normal and the excess cannot be balanced by increasing his drinks, then he will need fluid by another route If it is a deficiency not only of water but also of chlorides then a saline solution should be given Rectal infusion, preferably using ordinary tap water will sometimes permit the absorption of relatively large amounts of fluid but it is uncertain in action and should not be relied upon if it is desired to introduce more than 2 pints in 24 hours Intravenous infusion is a certain method of introducing fluid

Intravenous saline is thus indicated in simple dehydration Its use in shock is discussed on p 157 Heart failure and pulmonary congestion are contra indications Normal saline (0 85 per cent) which is isotonic with blood, is used, and it is important that it should be prepared from chemically pure sodium chloride and freshly distilled pyrogen free water and then sterilised on the same day Once sterilised it can be stored in a properly sealed container for several months It is conveniently put up in pint bottles from which it is administered in the same manner as is described for blood transfusion on p 154 except that filtration is unnecessary The "Vacoliter" is a proprietary apparatus of a very similar type and bottles can be obtained containing any of the standard intravenous solutions sterilised and ready for use

The amount of saline and the rate at which it is

given will be determined by the estimated fluid deficiency which it is intended to restore A large dose of saline can be introduced quickly to combat an emergency, but it is usually preferable to give a slow continuous drip A rate of 50 drops a minute equals 1 pint in 4 hours Provided pulmonary œdema does not develop there is no objection to continuing a drip infusion for three or four days if the patient is unable to take fluids by mouth If oral ingestion of fluids is impossible for any length of time, it is often an advantage to add dextrose to the infusion, thereby providing some nutriment A pint of 5 per cent. dextrose with 0 85 per cent. saline can be given alternating with a pint of normal saline

Infusion in Uræmia.—Administration of intravenous fluids produces diuresis and in uræmia advantage may be taken of this to encourage increased excretion of waste products, such as urea In Bright s disease infusion is better avoided as there is an alteration of the plasma proteins associated with albuminuria but in uræmia due to "surgical disease" of the kidney intravenous saline or, better still isotonic sodium sulphate (4 285 per cent) may be a life saving procedure.

Infusion in Head Injury—Hypertonic solutions are sometimes given to diminish cerebral œdema, and to reduce the pressure of the cerebro-spinal fluid For this purpose up to 100 c.c of 50 per cent. sucrose solution is given intravenously A less effective alternative is 6 to 8 ounces of 50 per cent. magnesium sulphate given rectally combined with a minimum of fluid intake by the mouth

Lumbar Puncture

This is carried out for diagnostic purposes as in meningitis and neurosyphilis when the cerebro spinal fluid is to be examined, or in spinal tumour when lipiodol is injected for its radiological localisation It

is used in treatment, as when penicillin or serum is injected in certain types of meningitis, for reduction of a raised intracranial pressure, and for the induction of spinal analgesia (pp 405 407, chapter on Anæsthetics)

The patient is placed in the left lateral position, the knees fully drawn up, and the spine and head flexed A line connecting the highest points of the iliac crests cuts across the 4th lumbar spinous process The space above or below this line is chosen, and a small wheal of local anæsthesia raised in the middle line, after appropriate preparation of the skin (Fig 71) The trocar and cannula are next introduced in a forward direction, with a slight



FIG 71.—Lumbar puncture (The site of puncture is usually between the 3rd and 4th lumbar spines.)

inclination upwards in conformity with the slight downward slope of the spinous processes The trocar is pushed steadily onwards, the resistance of the ligamenta subflava and dura is noted and overcome, and the subarachnoid space is reached at a depth usually of 2½ to 3 inches from the surface The trocar is withdrawn and clear fluid drips slowly from the cannula If the procedure is for the purpose of diagnosis the fluid is collected in a test tube and the pressure of flow estimated by manometer attachment if for therapeutic injection, a Barker s blunt-ended cannula is passed along that already *in situ* and a small graduated syringe attached Aspiration of a few cubic millimetres of clear fluid ensures the position of the cannula in the subarachnoid space, before the

slow injection of the drug is carried out (see Spinal Anæsthesia)

Difficulties may be encountered in the performance of lumbar puncture The trocar sometimes en counters bony obstruction, this may be due to in sufficient flexion to osteo arthritis, or to inaccurate direction of insertion The trocar is withdrawn to just below skin level, the spine fully flexed and reinsertion made with a slightly increased or decreased inclination With osteo-arthritis the 2nd or 4th space may be attempted but failure when this condition is present is not uncommon The sitting position with the feet supported on a chair at the side of bed or operating table, may sometimes be used the spine being well placed and the patient supported

The trocar may be pushed too far and penetrate the dura on the anterior surface of the spinal theca Thus, if no cerebro-spinal fluid flows from the cannula after apparently successful insertion, the trocar should be reinserted and the cannula withdrawn for a few millimetres If blood flows instead of cerebro spinal fluid, the plexus of veins on the posterior surface of the vertebral bodies may have been reached, and the cannula should be withdrawn and reinserted It is important that the instrument should not lie in this plexus when a drug is injected, hence the importance of aspiration before injection

In performing lumbar puncture in the very young the 4th interspace is chosen and the 3rd never used, for the spinal cord at birth reaches to the lower border of the 3rd lumbar vertebra and recedes gradually in succeeding years to its final point of termination at the lower border of the body of the first lumbar vertebra

Cysts—Bursæ—Tumours

Sebaceous cysts can occur anywhere on the surface of the body except upon the palms of the hands and upon the soles of the feet where sebaceous glands are

absent Their most common site is on the scalp, where not uncommonly they are multiple They are treated by excision, and this is carried out either by transfixion or by dissection By the former method, a long curved scalpel is passed beneath the cyst, perforating the skin on one side its point emerging on the other By cutting outwards, the cyst is bisected The sebaceous material is wiped away and the two halves of the cyst wall removed One or more sutures close the skin incision (Fig 72)

By dissection, a small elliptical incision is made over the swelling, and the cyst removed whole, together with the overlying skin by blunt dissection



Fig 72.—Excision of sebaceous cyst by transfixion.

Dermoid cysts may occur deeply in many parts of the body Superficially, they often present just above and outside the outer canthus of the eye, being here attached to the periosteum deeply or to the dura mater Their removal is delayed until puberty by which time any intra-cranial connection is usually separated Excision is carried out through a small incision in the line of the eyebrow, care being taken in separating it from its deep attachments

Cysts of the Breast.—Many varieties of cyst occur in the mamma. Solitary cysts are frequently so tense that they resemble solid tumours they are commonly associated with interstitial mastitis but are occasionally due to obstruction of lymphatics or of a galactiferous duct. They should be excised under local or general anæsthesia through a small incision radially placed to the nipple, together with the immediately

surrounding breast tissue. Alternatively, a large swelling may be removed through a curved incision in the line of the outer and lower attachment of the breast, the latter being turned upwards and the swelling removed from its deep aspect. The scar is thus concealed.

Single solid innocent tumours, such as fibro-adenomata, may be removed by similar methods.

Pilonidal sinus is a sinus of developmental origin in the post anal region. Its opening on the skin surface lies in the mid line of the natal cleft near the tip of the coccyx, and will admit a probe. Its track passes upwards for an inch or so in the subcutaneous tissue, to end blindly in the region of the sacro-coccygeal joint. It has no connection or association with the anus, and the direction of the track, upwards and superficial to the coccyx, differentiates the condition from anal fistula. The track is lined by squamous epithelium, and often contains a "nest of hairs" from which the name 'pilonidal' is derived. The sinus may remain undetected, or a purulent discharge may attract attention. Alternatively the opening may become blocked with epithelial debris, so that a cyst is formed the so-called post anal dermoid. This cyst may become infected and, pointing directly through the skin, is readily mistaken for a boil, unless the mid line opening is sought with a probe. All "boils" at the upper end of the natal cleft call for a search for such an opening, which may be 2 inches or more distant, but always in the mid line. Anything short of total excision of all the epithelial lining will be followed by recurrence. It is convenient to inject a dye, such as indigo-carmine along the track with a syringe and blunt cannula. The stained area is then widely excised and if excision is adequate no dye will be seen in the operation field. The skin is carefully sutured, and deep tension stitches tied over a roll of dressing, maintain pressure on the wound and discourage the

formation of a hæmatoma The patient should be nursed on his back for the same reason

Bursæ

Chronic bursitis, dependent upon repeated minor traumata producing persisting distension of the sac with fluid is commonly seen in the prepatellar and olecranon bursæ and occasionally in that overlying the tuber ischii Adventitious bursæ sometimes develop, e g the bunion over the metatarsal head in cases of hallux valgus The treatment of such a swelling is usually excision

Prepatellar Bursitis.—Comparatively early cases, with a still thin bursal wall are sometimes cured by aspiration followed by the application of a pressure bandage The process can be repeated if required and 1 to 2 c c of 2 5 per cent sodium morrhuate



Fig 73.—Excision of prepatellar bursa.

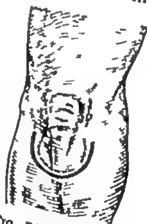


Fig 74 —Excision of olecranon bursa.

solution introduced Should this fail to cure the condition, and in all older examples excision is carried out under local or general anæsthesia. A curved incision is made on the *outer* side of the swelling so as to avoid the infrapatellar branch of the long saphenous nerve (Fig 73) The flap so made is

turned inwards, the bursa excised, and the flap sutured in position A small drainage wick is brought out at the lower end of the incision

The **olecranon bursa** is similarly treated when chronic swelling is present, the base of the flap being proximally placed (Fig 74)

A **bunion** is due to infection of the adventitious bursa over the prominent head of the first metatarsal in cases of hallux valgus With its removal is combined excision of the underlying exostosis or a more radical operation for hallux valgus (see p 206)

Ganglion

The swelling is due to mucoid degeneration of the fibrous sheath of a tendon or joint It is usually small, firm, and discrete, but occasionally it is large, diffuse, and soft The treatment of choice is excision, and this is carried out under local or general anaesthesia The incision passes across the swelling the edges are undercut, and the ganglion defined by blunt dissection It is of importance that every deep ramification should be removed especial care being exercised in tracing the deep connection with tendon sheath or joint cavity This latter connection is ligated and the pedicle cut short, when the capsule is finally removed

Treatment by injection and by the use of seton, is usually followed by recurrence

Compound ' ganglion, a term which should be avoided is a tuberculous infection of the tendon sheaths of the wrist and fingers Free excision gives the best prospect of speedy and permanent cure.

Lipoma

Lipomata occur anywhere in the body where fat is deposited The subcutaneous variety are commonly situated on the trunk, especially in the scapular region, and on the more proximal parts of the limbs

and in the neck Their situation, lobulation and definite edge render diagnosis usually simple In the abdominal wall it should be remembered that a small hernial sac may lie beneath the mass, especially in mid line swellings and in the region above the iliac crest, the triangle of Petit Large lipomata require excision either for cosmetic reasons or by virtue of their inconvenience at or near areas subjected to pressure Small swellings at other sites require no treatment An elliptical incision is made over the tumour under local or general anæsthesia the edges undercut, and the tumour is shelled out Drainage is provided for 24 hours

Multiple small and tender lipomata occur sometimes in association with cutaneous sensory nerve endings, and in children mixed fatty and vascular tumours occasionally occur

Papilloma

Simple papilloma of the skin is cured by the application of one drop of strong nitric acid, which is applied by a match-stick, and confined strictly to the wart. On the tongue cheek, and lips excision must be carried out by means of an elliptical incision surrounding the swelling Multiple infective warts are of several types and are usually cured by electric cauterisation

Fibroma

Fibromata of the subcutaneous tissues are either simple or associated with fat and occur in many and diverse situations They are frequently multiple occurring along the course of the smaller nerves (von Recklinghausen) but occasionally are single and of moderate size The interdigital cleft is a not uncommon situation for such a swelling The treatment of single fibromata is excision, removal under local anæsthesia being a simple proceeding

Angioma

Small and localised capillary nævi in infants frequently disappear spontaneously, and thus active treatment should be withheld in the early stages If they persist, and especially if the tumour be situated on the face, the application of carbon dioxide snow is the treatment of choice For cavernous angioma in this situation electrolytic methods should be used Elsewhere in the body where the swelling is localised and excision is practicable, surgical removal is required It is of advantage to wait until the patient has passed the infant stage before this is carried out, and in mid line nævi of the scalp of cavernous type the frequency of venous connections with the intracranial sinus must be borne in mind

Excision is usually carried out under general anaesthesia with cavernous angiomata, and nævo-lipomata the incision surounds the swelling and is carried down to the deep fascia, then by blunt dissection, the deep vascular connections are defined and tied and the mass removed *en bloc* The skin edges are mobilised by undercutting and the wound closed with sutures

Carbon dioxide snow is prepared by allowing liquid carbon dioxide to escape from the cylinder into the air expanding as it does so For this purpose a



FIG 75 —Mould and rammer for making carbon dioxide snow pencil.

special type of cylinder is used which stands vertically on a flat base and has a tube inside so that liquid CO_2 is delivered to the valve from the bottom of the cylinder The ordinary cylinder of an anæsthetic machine

is designed to deliver gaseous CO_2 from the top of the cylinder, but if it be held upside down then liquid CO_2 will escape from the valve and snow will be produced. The snow is collected in a bag of flannel or chamois leather and transferred with a teaspoon to a wooden mould (Fig 75), into which the rammer presses the snow down to form a "pencil". A more expensive but more portable apparatus is obtainable, in which the CO_2 is derived from a miniature 'Sparklet' cylinder.

The pencil is applied with a firm pressure for some 10 or 15 seconds according to the size of the lesion. No anæsthetic is necessary. After the application the part is white and hard and appears to be frozen; after a few minutes thawing occurs. About half an hour later a wheal develops and still later vesicles may appear the contents of which can be evacuated under sterile conditions. A crust of necrosed tissue forms beneath which healing occurs and thus should be complete within a fortnight.

THE LIPS AND MOUTH

Cysts

Cysts in this situation are not uncommon. They are usually retention cysts of mucous glands, though a dermoid variety is sometimes found beneath the tongue.

Upon the lips and inner surface of the cheek, a mucous cyst presents as a small rounded bluish swelling which may occasionally discharge its contents and subside to recur later. On the floor of the mouth and beneath the tongue such swellings are larger, being there derived either from mucous glands or from the sublingual ducts (of Rivini) or from the glands of Blandin and Nühn. The larger cysts in this situation are referred to as *Ranulæ* and contain a clear mucoid substance.

The treatment is excision by reason of the constant inconvenience which is caused This is usually carried out under local anæsthesia, infiltration beneath and around the swelling with procaine (2 per cent) being adequate In some situations where tissues are lax, such as the floor of the mouth, infiltration is likely to obscure the cyst wall It is then wiser to use a surface application of cocaine (5 per cent.), but if the cyst is large or the patient nervous, light general anæsthesia is preferable An attempt is made to remove the whole of the cyst, and if this is done, the wound is closed by catgut suture Sometimes a part of the wall of the cyst is left behind, being adherent and often unrecognisable on account of the general oozing of blood In such case the wound is only partly closed, the centre being allowed to granulate from the bottom, so as to discourage recurrence of the cyst.

Salivary Calculi

These may occur in connection with any of the larger salivary glands, being most common in the submaxillary system The stone is either within the gland or at any point along the duct the commonest site being in the latter within an inch or so of the orifice in the floor of the mouth They result in obstruction to the outflow of secretion with swelling of the gland and duct and subsequent infection and abscess formation behind the stone With each meal, or with the anticipation of food, increased swelling of the gland and pain in its vicinity render the diagnosis evident The orifice of Wharton's duct is usually swollen and displaced and a little pus may be expressed the calculus is often felt by palpation in the floor of the mouth An X ray examination reveals the position of the stone

The treatment is removal of the calculus This is readily carried out under local procaine infiltration,

when the stone is situated in the floor of the mouth or close to it A small incision is made on to the stone, and after removal of the latter, the wound is left open Difficulty may be encountered when the calculus is placed near the commencement of the duct, and if it cannot be palpated through the mouth, it is preferable to excise the submaxillary salivary gland If possible, however, it is wise to allow a little time to elapse for the stone may pass on to the more accessible oral part of the duct It should be remembered that more than one calculus is sometimes present and so a preliminary radiograph is advisable

Papilloma

Papilloma of the cheek or tongue is treated by removal, a small elliptical incision being made around the swelling, which is excised with the mucosa surrounding its base

Other innocent neoplasms occur somewhat rarely upon the tongue or within the cheek, such as angioma, lymphangioma or lipoma though many of these by virtue of their diffuse nature may not be amenable to surgery If small and localised, excision may be practicable

Epulis

This is a general term given to several distinct swellings which occur in relation to the alveolar process A common type the granulomatous epulis arises at the side of a tooth or from a socket and is associated with local suppuration It consists of a spongy mass of granulations and is treated by removal of the infected tooth, the cleaning out of the socket and excision of the swelling itself, together with all tissue at and immediately surrounding its base The presence of such an epulis on an edentulous jaw strongly suggests the presence of a buried stump

A fibrous or fibro-sarcomatous epulis is sometimes

encountered The teeth on both sides are removed, an incision made through the mucous membrane in front and behind, and the swelling excised, together with the surrounding mucosa and a generous wedge of underlying alveolus the whole being removed in one piece The bone is cut with a chisel, or small saw Should the tumour, on histological examination prove to be a sarcoma, deep X ray treatment is to be considered

Dental Extractions

The removal of teeth, though properly the province of the dental surgeon, must occasionally be carried out in emergency by the medical practitioner who should be reasonably proficient in the art In dental practice a variety of forceps are used, differing with the tooth to be removed and this is of course, ideal For straightforward extractions however a medical practitioner can proceed with two pairs one for the upper and one for the lower jaw The former are of "universal" type and are straight, the latter are hawk's bill the blade being at right angles to the handles (Fig 76)

Local anæsthesia, nasal or oral gas is administered In the former 2 per cent procaine with adrenalin is injected beneath the mucosa of the alveolus *on the inner and outer* surfaces infiltrating up to the dental margins and a little is introduced at a similar level between the tooth to be removed and those adjacent to it

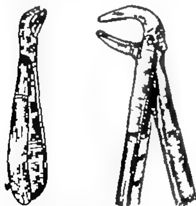


Fig 76.—Forceps for upper and lower dental extractions.

Slightly varying manipulations are to be remembered depending on the particular tooth

to be extracted The operator stands in front of the patient and slightly to his right, in dealing with all teeth excepting the right lower group, for these he stands behind and to the right It must be emphasised that pressure into the socket is all important that traction plays but little part and that only in the last phase The left hand is used to steady the lower jaw to keep the lips cheek and tongue aside, and to adjust the initial position of the forceps A rubber-covered dental gag being placed in position, the blades of the forceps are introduced, one on the oral and the other on the buccal or labial aspect of the tooth and thrust towards the roots Steady pressure results in the "starting" of the tooth from its socket between the blades of the forceps by which it is now gripped to a point well below its middle region The final traction is combined with subsidiary movements as follows

For lower molars which carry two roots, anterior and posteriorly placed a slight inward and outward rocking movement completes the extraction for upper molars with their two buccal and one palatal root, an outward tilt should be added at this stage for upper canines and incisors and for lower premolars and canines a slight rotation is indicated since these teeth carry single conical fangs for upper premolars (bifid roots) a slightly outward movement is added and for lower incisors whose single roots are flattened from side to side an antero posterior rocking is necessary

Complications.—Elevators are sometimes required for the removal of a root which has broken, or for the extraction of a wisdom tooth. The presence of an adjacent empty socket facilitates the former operation the elevator being thrust through the dividing partition and displacing the root which may then be grasped with forceps

Occasionally a root may be driven into the maxillary

antrum, it is removed by enlarging the opening, packing the cavity with ribbon gauze and withdrawing it, when the fragment emerges with the strip

Hæmorrhage, either primary or reactionary, may be persistent If a bleeding vessel is seen a stitch may be sometimes passed round it or a fragment of mucous membrane sutured on to it Such measures not infrequently fail If this is the case or if the point is indistinguishable the socket is washed out and plugged with ribbon gauze soaked in adrenalin or turpentine oil, alternatively, snake venom is applied in the same manner Should hæmorrhage still persist in spite of the above measures, an electric or a Paquelin's cautery can be used under gas and oxygen anæsthesia (Ether must of course be avoided) Occasionally blood transfusion is required

Alveolar abscess may result from apical infection a swelling of varying degree presenting on the side of the alveolus and extending up to its margin Infection is apt to spread beneath the mucosa to the soft tissues around the body of the lower jaw or beneath those of the face Fluctuation should be awaited and an incision under gas anæsthesia is then made within the mouth as near the tooth as possible The dental condition is dealt with subsequently

Tracheotomy

In cases of urgent respiratory obstruction a high tracheotomy is performed in preference to a low operation as the upper part of the trachea is more superficial, risk of mediastinitis from subsequent infection is less, and fewer important structures are endangered

A tracheotomy for diphtheria is accomplished as follows If an anæsthetic is desirable chloroform gas and oxygen or cyclopropane should be given as ether is irritative and so apt to cause spasm of the glottis The child is pinned in a blanket so that a sudden

movement of the arms may not embarrass the surgeon When preparations are complete a small sand bag is inserted behind the neck, and an assistant keeps the head strictly in the mid line

The surgeon stands at the right side of the patient and places his left index finger on the upper border of the cricoid cartilage and makes an incision vertically downwards for one to one and a half inches, dividing skin fascia platysma pretracheal fascia and passing between the infra hyoid muscles If seen, the isthmus of the thyroid gland is pushed downwards Hæmorrhage is ignored A cricoid hook is then inserted under the cricoid cartilage and grasped in the left hand The hook steadies the trachea and brings it to the surface of the wound The trachea is incised with a scalpel, the second and first rings being divided from below upwards A tracheal dilator is inserted through the wound, the cricoid hook removed and the edges of the tracheal wound are gently separated, the surgeon placing a swab over the wound so that the violent expiratory effects which follow do not spray infected membrane mucus and blood over himself and assistants When respiratory efforts have become less violent a tracheotomy tube on a pilot is inserted into the trachea the dilator is removed, and the surgeon keeps his finger on the tube while the assistant ties the attached tapes around the patient's neck The inner tube is then fixed in position and one or two silkworm-gut stitches are introduced if necessary Anti-diphtheritic serum is given and a nurse remains in constant attendance a bronchitis kettle being provided to prevent chest complications and also a feather or pipe cleaner with which to clear the tube should membrane or mucus cause obstruction The inner tube is removed and washed in sodium bicarbonate solution every four hours, or more often if necessary and the tracheotomy tube itself can usually be dispensed with in four to seven days

The Umbilicus

Congenital Lesions are of frequent occurrence at the umbilicus

Hernia of this region may vary from a large sac with deficient abdominal wall (exomphalos) evident at birth and often incompatible with life, to a tiny protrusion seen only when the infant cries These are true umbilical herniæ, as also are the minor bulges resulting from a weakening of the scar Hernia in this situation in adults is usually acquired, being paraumbilical above or below through the linea alba.

Lesions resulting from imperfect closure of the vitelline duct may be a sinus fistula, or cyst and the occurrence of a fibrous cord running from the deep surface of the umbilicus to the lower ileum may onlybe evident at laparotomy Rarely a sinus fistula or cyst may remain from imperfect regression of the urachus

Infection in this region results from imperfect local hygiene, and varies from a superficial eczema to a localised abscess, which may discharge and leave a sinus, which is very resistant to treatment

Neoplasms at the umbilicus are usually secondary in type extending from the liver via the falciform fold, the primary focus being in the gastro-intestinal tract Occasionally a primary neoplasm may arise in a urachal remnant, or an epithelioma or rodent ulcer from the surrounding skin

Various Excrescences sometimes arise, these may be small adenomata from Meckelian remnants or bunches of granulations associated with local suppuration The everted mucosa of a sinus or fistula may suggest a tumour but a small aperture indicating the lumen becomes evident when a search is made

Treatment of Umbilical Hernia (Figs 62 63 64 and 65)

In infants and young children this condition is usually cured by the use of an inflatable rubber truss

small lateral perforations They are available in lengths varying from 1 to 3 inches, and the outer extremity carries a flange for the attachment of fine rubber tubing They are inserted with the help of a trocar

The patient's bladder having been emptied by catheter, the skin of the lower abdomen is shaved and surgically prepared He is placed in the dorsal, half sitting position on his bed, and the area of dullness between the umbilicus and pubic symphysis is confirmed by percussion A small intradermal wheal of procaine solution is made in the mid line, half way between the two points The appropriate Southey's tube being selected and sterilised, its rubber tubing is attached, the trocar pierces this and is passed into the cannula A small incision ¼ inch in length is made in the wheal of procaine, and the trocar and cannula pressed firmly through this at right angles to the surface, into the abdomen Removal of the trocar is followed by the escape of ascitic fluid, the small lateral puncture in the rubber tubing closing automatically The cannula may be strapped or otherwise fixed in position the rubber tube leading to a collecting vessel at the side of the bed A half to one pint of fluid escapes per hour through one such cannula Two or more may be inserted if required

A flannel binder, or towel, of such breadth that it covers the abdomen to a point just below the umbilicus, is passed around the abdomen being continually tightened as the fluid escapes The lowering of intra abdominal pressure is thereby further attenuated

Where a Southey's tube is not available, a small trocar and cannula may be utilised the rush of ascitic fluid being arrested after each half pint has been removed, by pressure over the end of the cannula

The proceeding must be carried out with a technique which is fully aseptic throughout

The Rectum and Anal Canal

The Anatomy of the Ano-rectal Region

The mucosa of the lower rectum consisting of a columnar epithelium with numerous tubular glands passes into the upper part of the anal canal and is continuous with the stratified epithelium of the modified skin of the lower half of that canal A series of vertical folds each an inch or more in length the columns of Morgagni extend down from the rectum their lower extremities being joined by small semilunar mucosal folds the anal valves of Ball in the upper part of the anal canal (Fig 77)



Fig 77 —The anal canal showing the columns of Morgagni and the valves of Ball

Beneath the skin of the anus and extending slightly into the canal the external hæmorrhoidal venous plexus is placed draining outwards through the inferior hæmorrhoidal vein and connecting upwards with the internal hæmorrhoidal plexus. This latter is situated beneath the inner lining of the anal canal and lower rectum between it and the subjacent muscle and drains upwards in a series of radicles placed in the columns of Morgagni to the superior hæmorrhoidal vein above These radicles collect first into three main channels placed generally with two on the right of the rectum and one on the left, before their union to form the major vein above Thus in general, three columns of blood ascend in the general position of 3 7 and 11 o clock in relation to the circumference of the lower rectum These veins are devoid of valves.

The circular muscle of the rectum thickens towards the lower end, to form the internal anal sphincter the upper part of which is placed within the rectum. The longitudinal muscle placed outside this descends into the anal canal being joined by many fibres of levator ani. The mode of termination of this group below has an important bearing on the course of certain fistulous tracks. The main insertion is into the skin of the anal canal drawing in a circumferential groove about half way along this. This may be palpated, and is known as the intermuscular septum. Below and

lateral to this the external anal sphincter is placed being subdivided into three subsidiary parts by two offsets from the intermuscular septum which reach the anal margins below Thus the external sphincter is divided into three the subcuticular superficial and deep portions separated from each other by fibrous partitions representing the termination of the longitudinal muscle fibres (Fig 81 3). Outside this on each side the ischio-rectal fossa is placed

Examination of the Rectum and Anal Canal

This must always be carried out in routine order, inspection—palpation—proctoscopy, being followed when required by sigmoidoscopy The abdomen should always be examined in addition Inspection may reveal external tags of skin including the sentinel tag of a fissure, areas of pruritus openings of fistulæ, peri anal suppuration, occasional parasites or prolapsing structures from above On passing a finger a fistula or an abscess or a neoplasm may be felt A polyp within the rectum is usually palpable though uncomplicated hæmorrhoids are not felt Warning of a fissure may be given, when digital examination is attempted and the procedure causes pain In addition extra rectal structures such as the prostate the urethral bulb the base of the bladder the vagina, uterus and adnexæ, and the contents of the pelvic part of the peritoneal cavity are investigated as is also the coccyx in case of trauma

By Proctoscopy hæmorrhoids and polypi are examined and sometimes treated, and neoplasm and various types of proctitis may be studied With the patient in the left lateral or knee-elbow position the warmed and lubricated proctoscope is passed gently and firmly forward and upward through the anal canal, with the obturator in position the procedure should be painless

Sigmoidoscopy must always be employed when a source of rectal hæmorrhage has not been located in the lower part of the bowel by the foregoing methods

In addition it is used in the study of colitis, of benign and other neoplasm, and especially for biopsy. Preliminary preparation of the rectum is required. At the end of a day on light diet, a mild, non irritating laxative such as magnesia is given, and after the bowel has acted on the following morning the rectum is gently washed out with saline until the washings are clear.

A sigmoidoscope carrying a distal light within a groove in its barrel is convenient (Strauss' pattern). With the patient in the left lateral position, the well-lubricated instrument is introduced with the obturator in position. The direction is forwards and upwards until the anal canal is passed, then upwards and slightly backwards. The obturator is then removed and the lens piece carrying the light slipped in position. The hand bellows being attached, the gentle introduction of air opens up the bowel and the end of the sigmoidoscope is advanced under vision, being thus made to negotiate the bends and folds of the rectum without injury to the wall. By this means the rectum and lower pelvic colon are examined. The whole process must be carried out gently, and inflation of the bowel must be minimal. The rectal wall and contents are noted both during introduction and removal of the instrument. An anæsthetic is not necessary but some preliminary sedative is desirable for nervous patients.

Hæmorrhoids

External Piles are non vascular skin projections which may become inflamed, œdematous, and be the starting point of a pruritus spreading round the anus. They are treated by excision, local anæsthesia being adequate.

An ANAL HÆMATOMA, sometimes referred to as an external hæmorrhoid, is a small bluish swelling at the anal margin produced by the rupture of an external

hæmorrhoidal vein In the early stages, the application of lead lotion locally usually results in resolution In more persistent examples, a small amount of procaine 1 per cent solution is injected beneath the swelling which is then incised and the clot turned out The overhanging edges are trimmed away, leaving a small flat wound with a broader outer than inner extremity Daily dressing with eusol or flavine is followed by granulation and healing

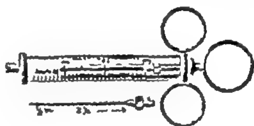
Internal Hæmorrhoids are enlarged venous radicles placed beneath the mucosa of the upper part of the anal canal, projecting from the columns of Morgagni and leading up towards the superior hæmorrhoidal vein above Being devoid of valves, pressure on the system above, whether by an extra rectal tumour such as that of pregnancy or of fibroids, or by chronically retained fæces in a constipated bowel, results in the dilatation of the lower extremities of the veins This may also result from portal obstruction above, such as a cirrhotic liver, and from obstruction to the venous return by a rectal carcinoma Thus, in all cases of piles a careful and routine abdominal and rectal examination must be made before treatment of the hæmorrhoids is instituted

Intermittent straining at a constipated stool is the common underlying cause of hæmorrhoid formation Thus prophylaxis consists in the proper attention to diet, to exercise, and in the occasional dose of liquid paraffin

Injection Therapy—This an ambulatory and painless proceeding is the treatment of choice Hæmorrhoids must be uncomplicated and unassociated with other rectal or anal lesion hypertension or obstruction to the portal drainage Epithelialised piles where the squamous epithelium of the lower anal canal has spread on to the surface of the projection (as shown by a grey spreading area over the lower pole of the hæmorrhoid) and fibrotic prolapsed piles are not suited to injection

In such partial and temporary success only are to be expected, and the condition will recur

The bowel is emptied on the morning before injection is to be carried out The patient assumes preferably the knee-elbow position, for the rectum thus falls away from the end of the speculum when this is introduced, instead of prolapsing a little into it, as in the left lateral position The proctoscope carries conveniently an attached internal distal light, though if this is not available, a head light is worn The injection syringe is of a special pattern (Fig 78) It can be used with one hand, and the needle is attached by a firm catch, lest the pressure required for the injection of an oily medium suddenly and forcibly project the needle from the syringe The needle is long and is provided with a shoulder so placed that too deep a penetration of the rectal wall is rendered impossible A solution of phenol 5 per cent in almond oil is used and 2 to 3 c.c. are injected at once Alternatively a 10 per cent solution is used, but of this not more than 10 to 15 minims for one hæmorrhoid The former solution is to be recommended


Fig 78.—Gabriel's syringe for injecting hæmorrhoids

The warmed and lubricated speculum being introduced, the obturator is removed, and the positions of the hæmorrhoids are noted. Usually three larger, primary piles are present situated at 3, 7 and 11 o'clock around the circumference, 12 being the anterior median position, and between these, one or two smaller swellings may be seen The exact position of the former piles being noted, the speculum is

advanced the needle is inserted immediately above one of them through the mucosa, the bevel being faced outwards, and the appropriate amount of solution is injected. A rounded submucosal swelling results; this is repeated for one of the other swellings at the same sitting. The injection is thus perivenous and above the hæmorrhoid. Examination one week later, when the next "sitting" takes place, reveals a firm indurated area, with disappearance of the varicosity.

Radical Treatment of Hæmorrhoids.—This is required where hæmorrhoids are epithelialised, prolapsing, or are associated with some other benign anal lesion. Ligation and excision is the operation of choice.

The bowel is prepared during the three days previous to operation by the taking of a light diet, a rectal washout being given about two hours before going to the theatre. Low spinal or local anæsthesia following a morphine-scopolamine injection are both satisfactory modes. Otherwise a general anæsthetic including ether is required. For local anæsthesia, the patient is placed in the right lateral position with the knees drawn up and the buttocks projecting over the edge of the table. A wheal of procaine 1 per cent is made subcutaneously in the mid line 1 cm. in front of the anus and another 1 cm. behind it. A finger is then passed into the anal canal and a long needle attached to a 20-c.c. syringe containing 1 per cent procaine is entered through the posterior wheal. Guided by the finger in the anal canal, the needle is made to pass into the external sphincter and 5 c.c. of solution is injected on each side so that the posterior half of the muscle is infiltrated. The same procedure is adopted for the anterior half of the sphincter, 20 c.c. in all being used. Usually this gives sufficient relaxation and anæsthesia for the excision of piles, though a small additional injection may be required into the tissues around large hæmorrhoids.

The patient being now placed in the lithotomy position, the anal sphincter is slowly dilated digitally Excessive stretching is unnecessary The three primary piles are dealt with first of all, commencing with the most posterior A pair of pile forceps is placed upon the projection and the muco-cutaneous junction is divided with scissors If a redundant skin tag is present this is included in the first incision A short pedicle containing the dilated vein and its accompanying artery with some areolar tissue is obtained This is transfixed with catgut (No 8 chromic), and then firmly ligated The projecting hæmorrhoid is excised, leaving a generous cuff of tissue below the line of ligature The remaining two primary, together with any enlarged secondary, piles are similarly treated It is of importance that, when the operation is completed, a strip of intact mucosa should separate adjacent ligated vessels An ounce of sterile vaseline is introduced into the rectum, and a small tube carrying a length of ribbon gauze wound around its middle third is introduced through the anal canal it is so placed that with sphincter tone returning the gauze-covered area is gripped and comes in contact with the area of operation, diminishing oozing therefrom, and allowing the passage of flatus

After-care —An injection of omnopon is given post operatively and repeated occasionally during the first 86 hours Fluids only are taken by mouth until the end of the second day, when the first full dressing is done Four or five ounces of sterile and warmed olive oil is injected through the tube into the rectum A few minutes later the tube with surrounding gauze is removed An aperient is given on the fourth day and the diet increased as the bowel becomes regular The anal canal is irrigated daily with saline and after each action of the bowel Sitz baths are given daily after the fifth day, and liquid paraffin is taken by mouth

Should hæmorrhage occur shortly after the operation, and the bleeding point not be evident the rectum should be packed around a firm rubber tube so that even pressure is exerted upon the area of operation Retention of urine not infrequently follows the operation (p 238)

Prolapse, Thrombo-phlebitis, and Strangulation of Internal Hæmorrhoids

Prolapsed piles must be replaced by steady pressure with the vaselined finger Strangulated and thrombosed hæmorrhoids must on no account be treated by active surgery If it is impossible to replace them, rest in bed with the foot raised is required fomentations being applied to the mass at the anus Fluids only are given by mouth and liquid paraffin is administered the œdema usually subsiding and the piles becoming reducible though sloughing occasionally occurs (Fig 79) Subsequent injection, when the condition has subsided, will be required this bringing about the final fibrosis of the degenerate hæmorrhoid It is important to remember that operation in the acute stage of strangulation and thrombosis encourages local infection, and may initiate portal pyæmia



Fig 79 —Strangulated internal hæmorrhoids with thrombosis.

Fissure

A fissure in ano is an extremely painful ulcer within the anal canal It is frequently in the mid line posteriorly, and its site is marked by a small œdematous tag at its lower end at the anal margin the sentinel pile' (Fig 80 1) In its early stages a fissure is shallow and may be little more than a split in the inner lining of the canal later however it becomes

surrounded by induration, with hardened edges and acutely sensitive base The anal sphincters are in tight spasm, and the diagnosis is made on the history, for local examination without anæsthesia may be well nigh impossible

In its early stages a fissure can be cured by the

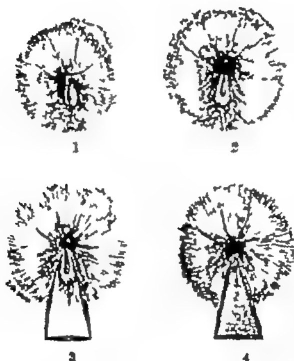


FIG 80 —The operation for anal fissure.

injection of proctocaine into the sphincter beneath it A small pledget with cocaine 10 per cent having been inserted for a few minutes into the anal canal a wheal of procaine 2 per cent is made one inch posteriorly Into this a needle attached to a 10-c c syringe containing proctocaine solution is passed, a finger being introduced into the anal canal as a guide The needle enters the external sphincter deeply, 2 c.c being injected beneath the fissure and 2 c c on each side

The spasm of the muscle is felt to diminish at once, and pain is relieved By this means not only is pain abolished for a prolonged period but locally rest is obtained for the inflamed area by the relaxation of the sphincter Fissures not yet indurated heal by this means, though two or more "sittings" may be required In the intervals, pure ichthyol is applied to the base of the fissure on alternate days The older method of simple stretching of the sphincter under anæsthesia is occasionally a useful measure, where injection is not available, or where the sphincters have become fibrotic from long-continued spasm

Radical Treatment (Fig 80) is carried out in fissure of a slightly later stage, when induration around and hardened edges render healing unlikely by other means where an œdematous sentinel tag is present, or fistula complicates it Local, low spinal, or general anæsthesia is employed, as described for hæmorrhoids With the patient in the left lateral or lithotomy position, the sphincter is gently stretched, until the fissure becomes evident The ulcer is excised, the wound going down usually to the sphincter The outward extremity of the wound is continued beyond the anal margin broadening for a short distance into the surrounding skin All hard indurated irregular, or overhanging edges are trimmed away the indurated superficial sphincter fibres are divided and a flat and smooth area remains which heals by granulation A tube is inserted into the canal and a small flat dressing of gauze tucked in between the tube and the wound

An application of 40 per cent tannic acid in flavine solution or one of flavine with *liquid paraffin* is applied daily and is inserted within the anal canal

The general routine after operation resembles that following a hæmorrhoid operation

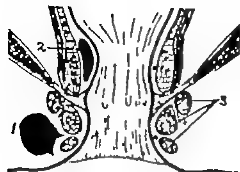
Fistula in ano

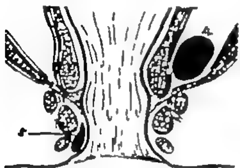
An anal fistula results from imperfect drainage of an abscess in the region of the anal canal An abscess here may be situated superficially at the anal margin and is then peri anal it may be submucous, within the canal, or it may be ischio rectal within the fossa In the last situation the lesion is usually acute of B coli origin though occasionally a tuberculous abscess arises from the breaking down of an ischio rectal gland An active tuberculous lesion is then usually present elsewhere in the body, and occasionally a pelvi rectal abscess above the levator ani occurs

An acute abscess requires adequate drainage as soon as diagnosed otherwise the development of fistula is certain

A Peri-anal Abscess (Fig 81 5) needs cruciate incision the corners of the flaps being cut away, leaving a perfectly flat surface without overhanging edge to heal by granulation A submucous abscess requires similar treatment after dilatation of the sphincter In addition in the former case th wound must be prolonged outward beyond the anal margin for a short distance into the surrounding skin, as in operation for fissure

An Acute Ischio-rectal Abscess (Fig 81, 1) is opened under general or spinal anæsthesia A generous cruciate incision is made over the swelling the pus is evacuated fibrous septa within the cavity are broken down the corners of the flaps are excised and the wound is rendered as flat and open as possible The healing of the lesion is carefully watched dressing by plugging being avoided lest pockets or deep tracks form Daily irrigation with hydrogen peroxide solution and eusol is followed by the laying on of gauze soaked in the latter so that even granulation from base to surface is encouraged Failure to drain a collection in this region results in the





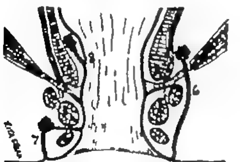


Fig 81 —Ano-rectal abscess and fistula resulting from it

1 and 7 ischio-rectal abscess.
2 and 8 submucous ano-rectal abscess.
3, the external sphincter
4 and 6, pelvi-rectal abscess.
5, peri-anal abscess.

discharge of the abscess contents through one or more tracks constituting an anal sinus or fistula (Fig 81, 7)

Fistula

A sinus, or blind fistula, has one opening only, and this may be situated within the anal canal or at the margin of the anus

Frequently more than one opening is found A simple type, resulting from peri anal or submucous infection has one opening within the canal and one at the margin, the track being superficial to the sphincter This is the submucous or subcutaneous variety In another type the track passes from an opening within the canal often at the anal intermuscular septum through the external sphincter ; running between two of the muscle subdivisions of the latter to an outer opening by the anal margin This is the anal variety

The inner opening is not uncommonly found in the

mid line posteriorly, the track passing through or above the external sphincter, round the anal canal to a point at one side. This is sometimes complicated by a second track passing from the same inner opening around the other side of the canal, two openings externally being thus present, one on each side of the anus. This constitutes a horse-shoe fistula, and those tracks having external openings in relation to the posterior half of the anus tend to be of this type.

Additional openings or tracks are sometimes present. An abscess above levator ani pelvi-rectal, may result in a track passing through the muscle and through the ischio-rectal fossa to the surface.

The treatment of an anal fistula frequently requires careful planning. It is carried out under general or low spinal anæsthesia, with the patient in the left lateral or lithotomy position. The sphincter being dilated, a grooved director with a broad blunt end explores the distribution of tracks and openings.

A blind fistula passing superficially to the external sphincter is rendered complete by thrusting a director along it and causing this to perforate the mucosa of the anal canal. The track is then laid open on to the groove from end to end, and the edges and base of the track are excised. The wound is prolonged into a broad outer extremity into the skin around the anus, the whole being left smooth and flat.

A complete submucous fistula is similarly treated.

A fistula penetrating the external sphincter must be carefully approached. If a portion only of the muscle is below the track, the latter is laid open from end to end upon a grooved director with division of the muscle fibres involved. As before, the edges and base of the track are excised and the wound extended outwards. If more than one third of the sphincter is below the track, a two-stage operation should be done lest division of all or a major part of the muscle result in the retraction of the cut ends, with their

ubsequent union by loose fibrous tissue, and incon- inence result

The Two-stage Method —At the first operation the rack is laid open from its outer end only as far as the dge of the sphincter, which remains intact across the irector The outer part of the track is excised and he wound prolonged outwards, as above A length f No 4 silk is passed along the remaining inner end f the fistula by aneurysm needle and the strand ed around the sphincter just sufficiently tightly to onstrict it By its presence during the succeeding eek or ten days, the strand provokes local inflam iatory reaction with adherence of the sphincter bres to surrounding tissues At the end of that me, a little local anæsthetic is injected and the ner end of the fistula divided by cutting through the hincter fibres at the site of the ligature The ack is now completely laid open and retraction of e divided sphincter is avoided

In horse shoe fistula, a similar process is used ach lateral track is opened up widely, from the iter opening, the edges and base of the track being eely excised One or more silk ligatures are passed ound the sphincter where this is penetrated, and the tter is divided some days later An extensive ound usually heals well if it is rendered as flat and smooth as possible

Complicated fistulæ may require three or more erations before all tracks can be safely laid open ounds must not be plugged dressings of eusol or vine being laid on daily Fistulæ resulting from lvi rectal infection passing to the exterior through e levator ani cannot be opened completely for vision of the inner sphincter is followed always by continence The track is excised upwards from the ver aperture a wide opening being made below e diseased track is followed and removed until the ator ani is passed The upper part is cauterised

Acute Infections of the Hand

The Anatomy of the Mucous Sheaths and Fascial Spaces

The spread of septic infection in the hand and its surgical treatment are governed by definite anatomical considerations, and the disposition of synovial sheaths, fascial spaces and planes must be briefly described

The *digital sheaths* of the index, middle, and ring fingers extend from the base of the terminal phalanx proximally into the palm, to the metacarpo phalangeal joint That of the little finger is continued as the *ulnar*, or *main palmar bursa*, broadening at the level of the middle of the metacarpals, and reaching up to a point 1 inch above the anterior annular (transverse carpal) ligament That of the thumb is continued proximally as the *radial bursa* beneath the anterior annular ligament to a similar level Frequently the two bursæ communicate beneath the ligament (Fig 82)

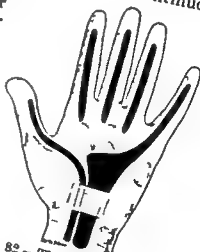


Fig 82 —The tendon sheaths of the hand.

Two main fascial spaces are present They are the thenar space and the middle palmar space The *thenar space* is bounded behind by the adductor pollicis by which it is separated from the first interosseous space on the outer side by the radial bursa surrounding the flexor longus pollicis and on the medial side by a strong septum passing obliquely backwards into the palm from the lateral border of the palmar aponeurosis to the shaft of the third metacarpal it is overlapped in front by the muscles of the thenar eminence on the outer side and the index tendons on the inner side It communicates distally with small

fascial canals along the two lateral lumbrical tendons, being closed proximally and continuous with the first interosseous space between the thumb adductors

The *middle palmar space* is placed behind the ulnar bursa which surrounds the flexor tendons in front of the fascia covering the metacarpals and interossei lying laterally to the hypothenar muscles and medially to the thenar space, and being separated from the latter by the strong fascial septum described above It is continuous distally with fascial canals along the two medial lumbrical muscles and proximally beneath the anterior annular ligament with the deep space of the forearm

A dorsal sub-aponeurotic space is present beneath the extensor tendons as these lie upon the metacarpus

The Treatment of Acute Infections of the Hand

This often demands a judgment of the highest degree The correct time to operate (if at all) the placing of the incision, the degree of surgery to be practised, and the management and after-care—each of these must be carefully studied if the best result is to be obtained Indeed failure in one of these respects sometimes results in disaster

The type of infection is of prime importance Streptococcus pyogenes and staphylococcus aureus are responsible most frequently The former often arises in minor wounds such as pin pricks and abrasions and is the more serious The latter has its origin in local lesions such as follicular infection and is productive of a rather less severe condition Streptococcal infection so often a spreading lymphangitis or cellulitis produces pus when localised by the rising resistance of the patient, a process which occupies a variable time There is frequently no localisation of pus and incision of such a lesion is quite useless and may be dangerous through the spreading of the infection to areas uninvolved already

The use of penicillin, 15 000 units three hourly, by intramuscular injection will bring about the subsidence of many streptococcal and staphylococcal lesions, and the localisation of others as an abscess which is cured by its evacuation. Sulphonamide therapy is also of great help in this.

Staphylococcal infections localise with pus formation at an earlier stage and there is less tendency for the development of a generalised blood infection. In all cases, pus formation must be awaited before incision is made, and it is in the judgment of the right time for this that skill is especially required.

When surgical methods are to be adopted incision as full as possible, commensurate with the local anatomy, must be carried out so that the widest exit is given to the abscess.

After incision has been made, the edges of the wound are kept open by the aid of a short soft rubber drain such as a piece of rubber glove. This is kept in for about 30 hours before removal, and thereafter no further drainage material should be used. Rubber tubing must be avoided. Further all forms of through-and through drainage between different incisions should be omitted in the hand, this being both unnecessary and productive of adhesions.

Gas and oxygen or pentothal are adequate for small superficial abscesses including those of the pulp of the finger but otherwise incisions in the hands and digits should be made under general anaesthesia other than nitrous oxide. Complete relaxation of the forearm muscles is required and the operation should not be hurried. A procaine block around the base of a finger may be employed for incision of the pulp, but other than for this all local anaesthesia, including ethyl chloride spray, is to be avoided on account of the devitalising effect upon the adjacent tissues.

Erysipeloid is a common, though infrequently described lesion of the fingers. It occurs in those who

handle raw meat or fish, and is said to be due to the *Bacillus suipestifer* which enters the skin through a scratch Around the scratch is an ill-defined swollen erythematous area, associated with itching and a sensation of heat suppuration does not occur, nor are there constitutional symptoms or lymphangitis The red area tends to migrate to the base of the finger, to the web and even to an adjacent finger The condition may persist for two or three weeks and then disappear, but recurrences are not uncommon Treatment usually advised is the application of warm moist dressings, but this appears to have little or no effect on the course of the disease which is self limited Surgery is contraindicated, as there is no pus for which to provide drainage Sulphonamides are useless, but penicillin hastens recovery

Whitlow

Infection of the finger is either subcuticular, subcutaneous periosteal or thecal

Subcuticular whitlow is treated by trimming away the raised epithelium If, as frequently happens a small opening from the subcutaneous tissues is found, treatment of the deeper infection must be carried out

Subcutaneous whitlow is an infection of the pulp of the finger The pulp is subdivided by fibrous trabeculæ into numerous compartments, and suppuration is early associated with a rise in tension in the part Thus the bony phalanx may be early attacked and may necrose and delay in treatment or injudicious incision is liable to spread infection to the tendon sheath Subcutaneous whitlow is treated by a laterally placed vertical incision on a level with the anterior surface of the phalanx terminating a little below the distal joint



FIG 83—The incision for subcutaneous whitlow

(Fig 83) An incision on both sides may be required, and these are sometimes joined across the end of the finger in a U-shaped incision The latter addition is if possible avoided for the flap so formed retracts and the terminal scar may be broad and incapacitating The fibrous trabeculæ are broken down with sinus forceps

Paronychia is a variety of subcutaneous whitlow requiring special treatment It may arise from small wounds at the side of the nail pus forming around and beneath this If pus is present beneath the nail, this is avulsed, and a small vertical incision is made on each side from the medial and lateral corners of the nail bed proximally into the subcutaneous tissues By this means a small flap is raised a strip of rubber glove is placed beneath this and changed daily Where one side is affected only the nail is split vertically by passing the blade of sharp-pointed scissors beneath it and the affected half removed one incision from the corner of the nail bed being required Where the distal part of the nail is intact the nail is divided transversely and the proximal part and root only avulsed A flap is raised as before The patient has thus saved to him the useful function of the nail while the new structure is growing

Thecal Whitlow —Infection of the tendon sheath commonly arises by extension from a subcutaneous whitlow or from penetrating injury of the finger It may occasionally result from injudicious incision into the pulp of the finger especially by a badly placed ventral incision carried too far proximally The finger becomes uniformly swollen, the swelling extending into the palm The part is reddened and painful both flexion and extension of the finger at all joints being resisted Incision is carried out on the side of the finger nearer the palmar than the dorsal surface the whole length of the sheath being laid open from the terminal joint up into the palm for fully an inch

above the root of the finger Sometimes the incision is interrupted at the level of the proximal inter phalangeal joint, thus preserving the skin flexure at the level of that joint (Fig 84, 4 and 6)

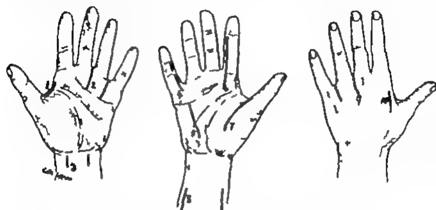


Fig 84 —Incisions for infections of the hand.

1 and 10, for thenar abscess.
2, for middle palmar space infection.
3, incision of upper extremities of radial and ulnar bursae.
4 and 6, for thecal abscess.
5, for ulnar bursitis.
7 for radial bursitis.
8, for deep space of forearm.
9 for lumbrical bscess.

Ulnar or Palmar Bursitis (Fig 84 5)

Infection of the tendon sheath of the little finger may readily spread to the ulnar bursa, with which it is continuous In such case the digital swelling and tenderness is continuous into the palm, which is swollen below the anterior annular ligament, and may extend above this for an inch or more Flexion and extension of all four fingers is extremely painful and actively resisted There is oedema of the dorsum of the hand

When the whole bursa, including the sheath of the little finger is affected the digital part is opened throughout its whole length on the inner side and the incision prolonged into the palm to a point just distal to the anterior annular ligament The super ficial palmar arch crosses the ulnar bursa in a

transverse line crossing the palm at the level of the web of the fully abducted thumb and should be secured A further incision may be made vertically from the proximal border of the anterior annular ligament (corresponding to the distal skin crease at the wrist) upwards for an inch in line with the foregoing incision (Fig 84, 3) The bursa is thus laid open above and below the ligament, and can be irrigated through with normal saline It is some times found that the distal part only is involved, this being the result of a narrowing of the bursa as it passes beneath the anterior annular ligament, ad hesions forming at this point Incision is then con fined to the distal part of the bursa

Radial Bursitis (Fig 84, 7)

The whole or part of the radial bursa is sometimes acutely infected and organisms may reach it by extension from a subcutaneous whitlow of the thumb by penetrating wound or by extension from the ulnar ursa The latter route of infection is unusual, for ne communication between the two bursæ is small id present in only about 50 per cent of subjects The thumb is uniformly tense swollen and painful terminal phalanx is held partially flexed the elling extending to the radial side of the palm and sometimes above the anterior annular ligament to the lower forearm All thumb movements especially flexion and extension are painful and actively resisted and there is tenderness all along the palmar aspect

The bursa is opened through an incision commencing at the level of the distal joint of the thumb on the inner side and passing upwards to the palm along the inner side of the thenar eminence It must terminate at a point not less than 1 inch distal to the lower crease at the wrist lest the branch from the median nerve to the thenar muscles be divided This crosses the radial bursa just beyond the anterior

annular ligament When the infection has reached the proximal end of the bursa, a further incision is required above the ligament vertically placed an inch in length and extending to the distal wrist crease on the radial side of the middle line (Fig 84, 8)

Infection of the Thenar Space (Fig 84 1 and 10)

A radial bursitis if unrelieved by incision, may spread to the thenar space, in the lateral boundary of which the bursa is placed From this point pus may spread backwards between the two parts of the adductor pollicis to the first interosseous space or distally along the two lateral lumbrical tendons to the dorsum of the hand at the base of the index finger Infection of the thenar space may also result from subcutaneous infection of the hand or from penetrating wound There develops a tense and painful swelling to the medial side of the thenar eminence filling out the web between thumb and index finger and producing marked œdema of the dorsum of the hand

A vertical incision is made on the outer side of the second metacarpal on its dorsal aspect, forceps being passed forwards through the interosseous space into the thenar compartment Alternatively an opening may be made along the web between the thumb and index finger on the ventral aspect, forceps being thrust upwards into the space in front of the adductor pollicis A disadvantage of this incision is that a degree of contraction of the scar may lead to a subsequent limitation of the freedom of thumb movements An abscess within the first interosseous space is opened by the same incision

Middle Palmar Space Infection (Fig 84 2)

This condition results from direct spread from an unrelieved ulnar bursitis from rupture of an infected digital sheath, or following wounds of the palm There is produced the typical "fat hand" tensely

swollen and generally painful in the centre with filling out of the interdigital clefts oedema of the dorsum, and immobility of the fingers

The space is opened through parallel vertical incisions starting at the webs on each side of the middle and ring fingers and extending into the palm for 1¼ inches Forceps are thrust upwards into the middle palmar space

As in thenar infection the process in the middle space may spread along the medial two lumbrical tendons to the dorsal aspect of the hand, pus present ing on either side of the base of the middle or ring fingers This constitutes a lumbrical abscess and is opened through a vertical dorsal incision over the swelling extending up to the base of the web (Fig 84 9)

Infection of the Dorsal Sub-aponeurotic Space

Pus in this position is uncommon though swelling and oedema are very usual resulting from the pre sence of infection in the palm A dorsal abscess arises from subcutaneous local infection as a result of open wounds or from spread from a lumbrical abscess It is opened by an incision on one or both sides of the extensor tendons vertically placed

Deep Infection of the Forearm (Fig 84 8)

An unrelieved ulnar or radial bursitis or a middle palmar space infection sometimes spreads proximally in which case an abscess forms beneath the flexor sublimis digitorum and upon and between the flexor profundus and the flexor pollicis longus This is opened through an incision on each side of the fore arm on a plane level with the anterior surfaces of the radius and ulna, forceps being passed into the abscess from each side beneath the superficial tendons

After-treatment

Rest in all cases is demanded both before and after operation and whether this is carried out or not

Thus immobilisation of a finger by a light malleal aluminium splint in a partially flexed position is be recommended in thecal infection This is t position of comfort for the patient, and allows t later mobilisation for the breaking of adhesions to more effectually carried out In palmar infection, small and light plaster dorsal splint may be used, t wrist being very slightly dorsiflexed and the aluminiu finger-splint incorporated in this Splintage shou not be used unless it brings comfort for the patient

The great value of penicillin in the pre and pos operative phases is repeated and emphasised

Local applications have little benefit and are un *necessary if incision has been adequate* Afte removal of the rubber drain a sterile paraffin dressin is applied, being changed every two or three day The less dressing and inspection of the wound th better An occasional *hypertonic saline bath* ma clear away crusts and allow the exit of a localise collection of pus, but they should be infrequent Bier's passive congestion is unnecessary in a patien whose normal reparative processes are active an whose resistance has risen sufficiently to form pus

In thecal and palmar infection, when the conditio is subsiding steadily after incision, active finge movements are encouraged after the fifth day an passive movements given after the seventh I residual stiffness is marked, the fingers should be put through a full range of movement under general anæsthesia.

Sloughing of tendon may be the cause of delay in healing or of sinus formation and is treated by removal of the affected tendon The finger is thereby rendered much less useful, and may require amputa tion later should it incapacitate the patient in his work. Necrosis of a phalanx is treated by seques trectomy at the appropriate time with, if required, a suitable ' trimming of the finger

Other Minor Operations on the Hand

Dupuytren's contracture is a deformity due to contracture of the palmar fascia. It usually affects the ring finger first though the little and middle fingers may also be involved later. The metacarpophalangeal and proximal interphalangeal joints are flexed but the distal interphalangeal joints are unaffected. Although the results of operative treatment are disappointing, and recurrence of the deformity readily occurs multiple subcutaneous division of the contracted fascial bands does sometimes prove satisfactory. General or local anaesthesia may be used. A point is chosen where the skin is not adherent to the fascia and a small tenotome is inserted between the two, dividing the thickened band from before backwards. The knife must not be carried too deeply, or the flexor tendons may be damaged. Too much straightening of the finger at once is to be avoided, as the skin easily tears and it is best to divide the fascia in five or more places at a time. After operation a splint should be worn for a week or so when exercises can be begun and the splint only worn at night. Recurrence up to long intervals after an initially successful operation is not uncommon. For the more severe degrees of contracture a more major procedure may be needed, the scar tissue being freely excised, the fingers straightened, and the resulting defect filled by a whole thickness graft.

Foreign Bodies

The removal of foreign bodies from the hand and elsewhere presents a problem different in each individual case and no set procedure can be recommended. The line of approach must be planned with due regard, lest some important anatomical structure be damaged. Operation is apt to be of unexpectedly prolonged duration and this must be remembered in

Operation is required chiefly for secondary arthritic changes or for a painful bunion A tourniquet is applied above the knee and an incision is made along the inner border of the toe, exposing the metatarso-phalangeal joint The ligaments of the joint are divided and the base of the proximal phalanx is dislocated into the wound and then excised with bone forceps The osteophyte on the inner side of the meta tarsal head is chiselled away, and the toe is straight ened A small amount of redundant skin can be excised and the wound is closed The toe is bandaged to keep it straight, and afterwards suitable shoes with straight inner borders must be provided This radical operation is indicated when there are arthritic changes present but if a bunion is the sole disability, it is often wise, especially in the elderly to neglect the valgus deformity and to restrict opera tion to removal of the bunion and underlying osteophyte

Hammer toe is a deformity in which the proximal phalanx of the toe is dorsi flexed and the middle phalanx is plantar flexed while the distal phalanx may be either dorsi or plantar flexed As a result the ' knuckle ' of the proximal interphalangeal joint projects upwards, and a callosity develops on the dorsum of the joint The second toe is that most commonly affected Early cases can sometimes be treated by strapping the toe down to a splint, and providing suitable footwear Operative treatment in later cases must be delayed until any local infection has subsided The callosity is then excised by an elliptical incision with its long axis transverse. The extensor aponeurosis is divided transversely the joint is opened and the head and neck of the proximal phalanx are removed with bone forceps. Repair of the aponeurosis is unnecessary and suture of the skin completes the operation. The toe is ba 1 o as to keep the toe straight u ling is

General **AMPUTATIONS**

Amputations in the distal parts of the limbs are most commonly required following an injury. Modern surgery has made great progress in the treatment of wounds, and also in bone-grafting and skin-grafting so that primary amputation is indicated with far less frequency than hitherto. Conservatism should be the general rule, though if the blood-supply has been irretrievably damaged this is a positive indication for amputation. Less frequently amputation may be needed in cases of infection and of new growth.

The level of the amputation requires careful consideration in relation to prosthesis. An artificial hand is a poor substitute for the natural hand, so that there one should aim for the minimal sacrifice of tissue, keeping especially as much of the thumb as is possible. In the lower limb on the contrary the aim is to provide the ideal stump for one of the standardised types of artificial limb.

Amputation flaps are so shaped that their blood supply is adequate, that they cover snugly the end of the bone without either tension or redundancy, and that the resultant scar lies where it will not be exposed to friction from the artificial limb. In length they should be 1½ times the diameter of the limb at the amputation level, and they should consist of skin, superficial fatty tissue and deep fascia only. It is convenient to use a tourniquet in most cases, the limb being elevated for a few minutes before its application. The periosteum of the larger bones such as the radius and ulna should be removed from the terminal inch of the bone, and the edges left smooth and regular. Nerve trunks, including digital nerves, should be drawn down and divided as high as possible. The larger amputation wounds are always drained; this is not essential below the wrist or in the case of the toes.

Amputation through the Fingers

This should, if possible be carried out through the bone distal to a joint, rather than through the articulation, so that flexion and extension of the terminal fragments are retained If infection is present, a trans articular amputation should be performed The exact levels of the joints of the fingers and thumb should be studied

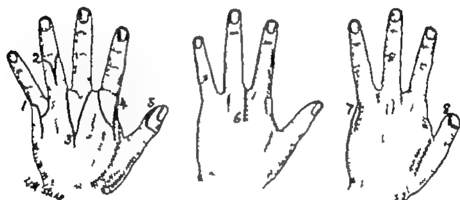


FIG 86 —Amputations through fingers and thumb
1 and 7 lateral flap for index or little finger
2, dorsal racquet for finger
3 and 6, racquet for middle or ring finger conserving interdigital cleft.
4, racquet (dorsi-lateral) for index.
5 and 8, palmar flap for distal phalanx ventral.

The Terminal Phalanx (Fig 86 5 and 8) —A single palmar flap is cut by transfixion The scalpel is passed through the finger from side to side at the level of the terminal joint, on the ventral aspect of the bone and directed distally The flap is cut The proximal ends of the incision are then joined across the dorsum of the digit the joint is opened and the amputation completed The flap is sutured in position

The Middle of the Finger —This is conveniently carried out through an oval incision forming a single palmar flap The point of section of the bone is marked on the surface and the incision begins at this

level dorsally, it passes obliquely across each side of the finger going down to the bone, and is completed on the ventral surface so that the length of the flap is a little greater than the diameter of the finger The flap is dissected up, and the phalanx divided just below the base leaving the flexor and extensor tendon attachments If it is impossible to save the base of the second phalanx, the dorsal and ventral tendons are cut a little below the joint and turned aside the articulation is cut through and the tendons sewn together over the end of the proximal phalanx. Thus an extension deformity of the stump is avoided If this cannot be done the amputation must be at the level of the metacarpo phalangeal joint

Alternatively to the above oval incision, double antero posterior or lateral flaps or a racquet (Fig 86, 2) may be employed, according to available tissue

At the Metacarpo-phalangeal Joint —This is co veniently performed through a racquet incision p ing ventrally round the finger at the level of the w and being continued into a vertical dorsal limb ov the metacarpal head and shaft The flap is raised front and continued around the sides of the finge until the joint is reached The tendons are divided the joint cut through and the finger removed In non manual workers where strength of grip is not the primary consideration, the metacarpal head is re moved the bone being sawn through its neck. The hand is thereby rendered more shapely

A modification of the racquet for the middle and ring fingers is that described by Sherwood The incision passes round to the sides of the finger crossing the web on one side close against the finger to be removed, and through the other web against the base of the adjacent sound finger The vertical limb of the racquet is dorsally placed ventrally the cut dips proximally in a short V The metacarpal is divided at its neck, and accurate suture of the wound results

in the reconstruction of the interdigital cleft A better cosmetic result is obtained (Fig 86 8 and 6)

In the cases of the index and of the little finger, a single U shaped flap may be used with advantage, placed on the radial side in the former and on the ulnar side in the latter (Fig 86, 1) The incision commences over the dorsal surface of the metacarpal neck, passes downwards well on to the side of the proximal phalanx, then turning forwards and up *again to a point on the palmar aspect opposite to that* of the commencement An incision connecting these two points is made around the base of the finger through the web The cut is carried firmly down to the bone, the flap is dissected up and the metacarpal head with the finger is removed

Alternatively, in these digits a racquet may be used the vertical limb being on the radial side in the index, and on the ulnar side for the little finger

Amputation of the Thumb through the Metacarpal

This is carried out, if possible, by the use of a wide semicircular palmar flap cut from the thenar region of the hand The scar is thus brought well back to the dorsum The flap is raised, a connecting cut is made across the web the adductor, short flexor and short abductor of the thumb are divided near their *insertions and the metacarpal sawn through* The above muscles are then sutured to the extensor expansion on the dorsum over the stump of the divided metacarpal and the flap stitched in position

Amputation through the Hand

No set procedure can be described The conservatism that is essential in dealing with injury here necessitates a special treatment for each case, depending on the extent of the lesion

Amputation at the Wrist

Disarticulation at the wrist leaves a bulbous stump It has the advantage that supination and pronation are retained, by virtue of the intact lower radio ulnar joint a function of definite advantage where an artificial appliance has to be worn

Where possible, the effort should be made to conserve part or all of the carpus, and the result is improved where the bases of these metacarpals with tendon insertions are retained in addition If the latter is impossible attachment of the flexor and extensor tendons to the carpal bones is of advantage The movement at the wrist and carpal joints, which is thus preserved is of great advantage, whether an artificial hand is to be fitted or not

The operation is carried out by using if possible, a single flap cut from the palm though injury may necessitate the utilisation of irregular flaps

Amputation through the Forearm (Fig 87)

A stump measuring 7 to 8 inches from the tip of the olecranon gives the best results Division of the ulna leaving less than its upper 8 inches, gives a stump to which the fitting of an artificial limb is impossible for in flexion it scarcely extends beyond the level of the anterior surface of the arm In the lower third of the forearm the flaps are often ill nourished and there is a tendency to union between the divided ends of the radius and ulna

It is convenient to use double flaps, equal in length, which give a terminal transverse scar In making the bone section, the limb should be in a position of full supination so that the radius and ulna are divided at the same level. Section of the bones below the level of the pronator radii teres leaves a stump in which pronation and supination are possible Division above this level results in a permanent state of supination In making the bone section the re

traction of the muscle upwards is conveniently made with a three tailed gauze retractor, the centre tail being passed between the bones The periosteum is removed from the lower ½ inch of the ends of the



FIG 87 —Amputation through forearm. Level of bone section is indicated

bones, and the edges rendered smooth The ulnar, median, radial, anterior and posterior interosseous *nerves are drawn down injected with alcohol crushed* and divided The flaps are sutured in position

Amputations in the Lower Limb

The amputation of toes is carried out through a dorsal racquet incision in a manner similar to that used for fingers The heads of the metatarsals are always retained

Amputations at a higher level must be considered in relation to prosthesis. Syme s amputation, which *gives an end bearing stump* is the only exception Artificial limbs are now standardised and amputation through the tibial or femoral site of election will produce the optimum stump on which to fit respectively a below knee or an above-knee limb Amputations at other intermediate levels are consequently no longer practised and are only of historic *interest*

Syme's amputation may be employed in gross injury to the foot distal to the malleoli where sufficient skin remains posteriorly for the fashioning of a

flap It produces a good end bearing stump with a tough well nourished skin flap For this reason it may be preferred in a working man who does not wish because of expense or occupational hazard to rely upon an artificial limb The stump however does not admit of fitting a proper artificial foot, and a disc of leather ('elephant boot') is all that can be worn Consequently it is often better to amputate through the tibial site of election so that a good prosthesis be fitted



Fig 88.—Syme's amputation

The patient lies on his back with the lower l of the leg and foot projecting beyond the end the table, and a tourniquet is applied around t lower thigh The surgeon stands at the end the table and makes an incision across the und surface of the heel from the tip of the externa malleolus to a point ½ inch below and behind the tip of the internal malleolus This incision goes right down to the bone, and its line lies about ½ inch more posteriorly than the direct path between these two points The foot is now fully plantar flexed and the ends of the incision are united by a further incision straight across the front, severing everything down to the ankle joint The ligaments of the ankle are then divided at first in front then at the sides and finally posteriorly strong plantar flexion being maintained meanwhile This leaves the foot only attached by the posterior heel flap and careful dissection, with the blade of the knife turned always towards the bone is required to free the flap from the os calcis without button holing it The soft structures surrounding

the stump are then drawn upwards, and the lower end of the tibia with the malleolus and the fibular malleolus are removed by a transverse saw-cut immediately above the articular surface of the tibia The posterior and anterior tibial nerves are pulled down, crushed, ligated and divided as high as possible The anterior and posterior tibial vessels and the saphenous veins are tied and the tourniquet is removed The flap is finally sutured in position, with a small drain inserted into each corner of the wound for 24 hours

Amputation at the Tibial Site of Election

The site of election for amputation through the tibia *is 7 inches from its upper end or "a good hand's* breadth " below the tibial tubercle A stump longer than 7 inches is of no advantage in fitting an artificial limb and its relatively poor blood supply may be a constant source of trouble even calling for subsequent reamputation Less than 4 inches of tibia does not provide sufficient leverage for the prosthesis and amputation through the thigh is preferable

The resultant operation scar must not be situated over the anterior aspect of the tibia. Antero-posterior flaps with the anterior twice the length of the posterior give the most satisfactory result. If lateral flaps have to be used because of the nature of the wounds they should be unequal, the external being preferably longer than the internal, but care must be taken to see that the resultant scar is well below the internal tuberosity of the tibia A long single flap is apt to slough at its extremity

A tourniquet is applied above the knee, and the proposed site of tibial section is marked on the skin. With their base at this level the flaps are cut, so that their combined length is slightly in excess of the diameter of the limb They consist of skin superficial fascia and deep fascia only and their corners are

rounded The muscles are divided just above the level of bone section, and the soft parts are drawn up by a three-tailed gauze retractor The periosteum is stripped with a raspatory from the bones at the amputation level and for an inch above. The fibula is sawn through first, so that it will be divided 1 inch higher than the tibia Next an oblique cut, downwards and backwards, is made in the anterior border of the tibia to a depth of ½ inch The saw is then withdrawn, and a fresh transverse cut ½ inch lower down divides the tibia Between these two cuts a small wedge of bone is thus removed, thereby bevelling the *sharp anterior* border of the tibia The anterior and posterior tibial arteries are secured, and then the tourniquet is released and any further bleeding points are dealt with The main nerves are crushed ligated and divided at as high a level as possible. The flaps are sutured with a small rubber drain inserted in each angle for 24 hours The stump should be immobilised on a back splint for a week after operation

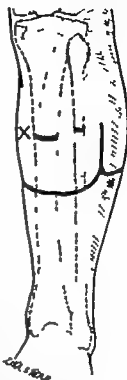


FIG 89 —Amputation at site of election in lower limb

Amputation at the Femoral Site of Election

The site of election for amputation through the femur is 10 or 11 inches below the tip of the great trochanter Longer stumps have a poor blood supply and also lead to difficulty in fitting an artificial knee Shorter stumps are practicable, though less efficient, and if very short, will require the tilting table type of limb It is best to use a single anterior

oval flap, which will result in a posterior transverse scar lying about $1\frac{1}{2}$ inches above the bony stump. In this situation the scar will not become abraded by friction of the limb as it would if it were in front. The hamstring muscles are divided 1 inch above the skin cut, so they shall not become adherent to the overlying scar. When the bone has been divided the linea aspera should be carefully bevelled, so that a protuberant spike of bone is not left posteriorly. The femoral and profunda vessels will require ligature and the sciatic nerve should be pulled down, injected with alcohol and divided as high as possible. The angles of the wound are drained, and the stump is suitably splinted. Flexion of the stump by elevation on a pillow after operation is to be avoided, as persistent flexion will interfere later with the satisfactory use of an artificial limb.

CHAPTER X

GENITO URINARY SURGERY

By A W Badenoch, M A , M D Ch M , F R.C.S

Instrumentation of the Urethra

Anatomy.—The male urethra varies from 8 to 10 inches in length It commences at the internal urinary meatus at the base of the bladder, and in its first part is surrounded by the prostate gland It then passes through the triangular ligament lying in the perineum, and becomes incorporated in the corpus spongiosum of the penis It traverses the ventral aspect of the latter organ to open on the glans at the external urinary meatus It is arbitrarily divided by the compressor urethræ into anterior and posterior parts There are three sites at which the urethra narrows at the external meatus, at the fossa navicularis just internal to this, and as the canal passes through the triangular ligament. At any of these points an instrument may be arrested

Instruments.—It is of great importance to have a proper selection of instruments in correct gradation and sound condition Apart from those used in endoscopy there are two types, hollow and solid

The hollow instruments, or catheters, are of many shapes, most of which vary only in slight degree. They are made of rubber, gum elastic web or metal The most generally employed are gum elastic. There are three main types of these (*a*) olivary tipped (Fig 90), (*b*) coudé (Fig 90), and (*c*) bi-coudé (Fig 90) For catheterisation of the normal urethra, (*a*) or (*b*) may be employed In the presence of a

stricture, an olivary tipped is necessary, and in a case of enlarged prostate a coudé or bi coudé A Harrison's whip catheter (Fig 91) may be an invaluable instrument in dealing with a stricture with false passages

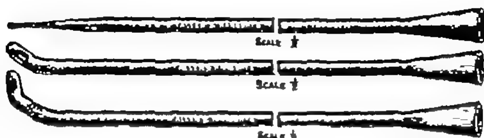


Fig 90 —Gum elastic catheters, olivary coudé, and bi-coudé



Fig 91 —Harrison's whip catheter



Fig 92.—Tieman's catheter

The solid instruments are known as bougies or sounds the latter term referring to pre-endoscopic days when the instrument was used to sound or explore the urethra and bladder They are made of metal or gum elastic web and are arranged in sets It is essential that a series should be graduated and complete. Gum elastic bougies are straight, firm but flexible, and are olivary tipped Metal bougies are curved at the tip, and have some degree of tapering,



Fig 93 —Buxton Browne s bougie



Fig. 94 —Clutton s bougie.



Fig 95 —Lister s bougie



Fig. 96.—Guyon s or Béniqué s bougie.

usually through four French or two English sizes The commonest types in use are those designed by Buxton Browne, Clutton, and Lister (Figs 93, 94, and 95) The Béniqué type has a double curve and is of advantage in certain cases of vesical neck obstruction

Calibration of Instruments

The size of urethral instruments is rather confusing since there are several calibration scales Those most

generally used are the French and English The former is preferable since each size represents the diameter in thirds of a millimetre The English scale is arbitrary The following is a comparison of the two scales

French	*English*	*French*	*English*
1	00	14	7
2			
		15	8
3	0	16	
4			
		17	9
5	1		
		18	10
6	2	19	
7			
		20	11
8	3		
		21	12
9	4	22	
10			
		23	13
11	5		
12	6	24	14
13		25	

It will be seen that the sizes can only be roughly compared with each other, and generally speaking the English size is about twice that of the French When dealing with narrow tight strictures it is advisable to use a French calibrated series since the English increases in size too quickly

The normal adult male urethra takes an instrument from 10 to 14 English, or from 18 to 25 French size.

Instrumentation.—The patient lies on a couch with the head resting comfortably on a pillow the legs being flat and slightly abducted The penis is swabbed with an antiseptic lotion such as biniodide

1 : 2,000 or oxycyanide of mercury 1 : 6,000. The prepuce is retracted and the glans and meatus are thoroughly cleaned. In passing a rubber catheter, great attention must be paid to asepsis, since the catheter is in contact with the operator's hands throughout its whole length.

The tip of the instrument is thoroughly lubricated—liquid paraffin (sterile) or preferably a water-soluble lubricant, being employed. The penis is grasped just below the glans between the fingers and thumb of the left hand, and is held almost vertically. In passing a gum elastic instrument the tip is inserted into the meatus and gently threaded along the urethral canal. Very little force should be necessary. If the instrument passes as far as the triangular ligament and is then felt to be obstructed spasm is probably the cause. By waiting a short time and then applying a little pressure the spasm almost always relaxes and the instrument slips through the prostatic urethra into the bladder.

In passing a metal instrument, on account of the curve, the manœuvre is slightly different. The penis is lifted up as before, but the instrument is held with the shaft lying horizontally and parallel to the right Poupart's ligament, the tip being downwards. The latter is now passed through the meatus and threaded along the canal. The handle of the instrument sweeps at first upwards and towards the mid line, but as the beak passes beneath the pubic arch, it is tilted downwards between the thighs. Obstruction sometimes occurs at the triangular ligament. This may be due to tilting downwards before the tip has entered the membranous urethra or to spasm. If due to the latter patience and gentle pressure will succeed.

After instrumentation sulphonamide should be given—sulphacetamide 0.5 gm. t.d.s. for 7 days. This applies after cystoscopy as well as after the passage of bougies and catheters.

Irrigation

(*a*) **The Urethra**—This used to be employed as a routine in the treatment of urethritis. It is still of value in non-specific infection which does not respond to chemotherapy. The apparatus consists of a reservoir connected by a length of rubber tubing to a nozzle. The flow from the reservoir should be controlled by a clip on the tubing. The nozzle is rounded at the tip and is provided with a shield to prevent splashing (Fig. 97). Various lotions are employed, those commonly used being potassium permanganate in various dilutions from 1 : 20 000 to 1 : 4 000 and oxycyanide of mercury 1 : 10,000 to 1 : 6 000. The lotion should be warm, 100° Fahrenheit, and the nozzle should be firmly, but not forcibly applied to the external meatus. During the irrigation the flow in the tube is controlled by pressure with the thumb and the index finger. When the anterior urethra is being washed out, the reservoir should not be more than 2 feet above the level of the meatus. In irrigating the posterior urethra, it should be raised a further 1 to 2 feet.

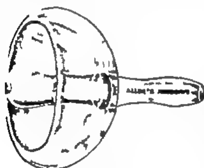


Fig. 97.—Harkness's urethral irrigator nozzle.

(*b*) **The Bladder**—This may be washed out, employing the technique as for the posterior urethra. If

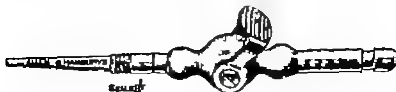


Fig. 98.—Irrigating nozzle with stop-cock.

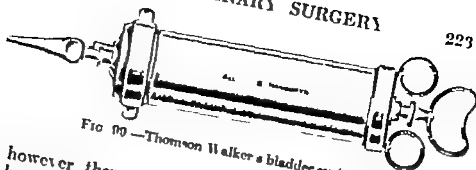


Fig 99 —Thomson Walker's bladder syringe

however there is any residual urine, a catheter must be passed This may be of any type but obviously, the bigger the lumen the better the wash Either a syringe (Fig 99) or an irrigator with a pointed nozzle (Fig 98) should be used It is better to introduce small amounts (3 to 4 oz) frequently than to fill the bladder once or twice Various lotions are employed oxycyanide of mercury 1 6 000 or a saturated boracic lotion being the commonest used

ANÆSTHETISATION OF THE URETHRA

Gentle manipulation is probably the most effective contribution to anæsthesia in urethral instrumentation There are, however some patients who are extremely sensitive, and in certain procedures such as cystoscopy a local anæsthetic will help No solution at present in use produces complete loss of sensation Almost equal in their effect are 5 per cent. novocaine or percaine or Ryall's solution

Cocaine hydrochloride	gram	0 5
Sodium bicarbonate	,,	0 5
Chlorbutol	,,	0 25
Distilled water	c.c.	100

Ten cubic centimetres of the solution are introduced into the anterior urethra using a syringe with a suitable nozzle such as that designed by Ogier Ward (Fig 100) The penis is compressed at the end between the thumb and forefinger and the

lotion is then milked along the canal through the compressor and into the prostatic urethra Another 10 c.c. of the solution is introduced and the penis is clamped just below the glans (Fig 101) The anæsthetic solution is left in the urethra for fifteen minutes Its efficacy is greatly diminished if it is not allowed sufficient time to act. A sacral block anæsthesia is more efficient than the above method since it diminishes the discomfort—often severe—which is felt on straightening the urethra For this purpose, a needle 3 to 4 inches long a 20-c c. syringe, and 30 c.c of 1 per cent. novocaine or percaine are required With the patient in the prone position the boundaries of the inferior outlet of the sacral canal are identified

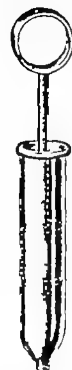


Fig 100 — Ogier Ward's urethral syringe

These are usually easily felt and consist of the tubercle forming the spine of the 4th sacral segment above and the cornua one on each side of the middle line, below The point of the needle is inserted midway between the two cornua and a small amount of anæsthetic is introduced The needle is now pushed in an upward direction so as to enter the sacral canal It passes along the canal until its point is felt to impinge on the anterior bony wall, usually at a distance of some 2 inches The piston of the syringe is withdrawn to make sure that a vein has not been entered and 30 c.c. of anæsthetic is slowly injected Anæsthesia will occur within 10 minutes This method of



Fig 101 — Thomson Walker's urethral clamp

anaesthesia is rather apt to be followed by pain in the region of the sacrum for 24–48 hours

METHOD OF TYING IN A GUM ELASTIC CATHETER

Unless a catheter is tied in aseptically and precautions are taken to avoid urethritis and an ascending infection the tied in catheter becomes one of the most dangerous methods in urinary therapeutics Sterile hands, sterile apparatus, and draping the area with sterile towels are essential requirements If facilities for such are not available, the method should not be employed.

The glans penis is cleansed the urethra washed out and a catheter passed in the usual manner Sulphanilamide powder is then dusted on the glans, especially about the meatus A "penile jacket is easily made with gauze and tape (Fig 102) It is boiled before use and wrung out in flavine. This is passed on to the penis containing the catheter and the tapes are tied Over this three sterile pipe cleaners are fixed in the manner shown in Fig 103

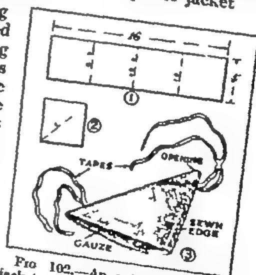


FIG 102.—An antiseptic "penile jacket made from gauze and tape

On no account should the catheter be allowed to drain into a bed bottle A well fitting sterile connection permits the attachment of rubber tubing which can be led off to a water seal bottle. In all cases of acute and chronic retention, the bladder in the first instance should be decompressed and there is no better method than

to employ the dripper of a continuous saline appa tus for this purpose (Fig 103)

Urethroscopy

The urethroscope consists of a metal tube cannula through which the urethra can be examin under direct vision The Swift Joly instrument, wh is the best for rout examination, consi of (*a*) a series of straig cannulæ of differ sizes, each fitted w an obturator and a combined opti and lighting system be attached to t outer end of t cannula after t latter s insertion T fitting of the two par is airtight, and the is a tap on the si of the viewing end to which a bellows can be attach and through which the urethra can be gently distend with air

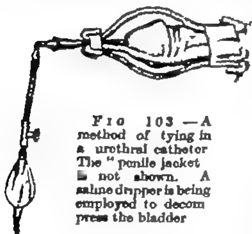


Fig 103 —A method of tying in a urethral catheter The "penile jacket is not shown. A saline dripper is being employed to decompress the bladder

Examination.—*The patient is prepared as f* urethral instrumentation No anæsthetic is necessar as the examination, though perhaps uncomfortable, rarely painful The urethra should not be irrigate beforehand A cannula with obturator is selected, s that it will snugly fit the external meatus It lubricated and introduced It should slide in quit easily by its own weight. The obturator is the removed a sterile swab on a probe is passed and th urethra is mopped dry If any blood is seen on th *swab the examination should be postponed to a* subse quent occasion since there is a danger if the urethr is distended, of death occurring from air embolism

The optical system, which has previously been tested, together with the bellows, is attached to the cannula The anterior urethra is now gently distended and the canal inspected throughout its whole extent as the instrument is slowly withdrawn

Indications for Urethroscopy

1 As a routine test for cure after urethritis

2 When acute urethritis has been treated for 5 to 6 weeks without resolution

3 Repeated difficulty in instrumentation when the presence of a false passage is suspected

4 Hæmorrhage from the penis unassociated with micturition (Note danger of air embolism)

5 Foreign bodies in the urethra

The commonest pathological lesions are (*a*) soft infiltrations (Fig 104 2) and (*b*) hard infiltration or stricture formation Soft infiltration when see at the stage of urethritis when urethroscopy is indicated appears as small pale areas varying in size from a pin head to a lentil, which stand out from the normal mucous membrane, and are therefore better seen in profile The number varies from one or two, in slight cases up to dozens in a severe case, when the whole mucous membrane may be studded with them The pouting orifices of the ducts of Littré may be seen, and occasionally a small Littré s abscess

When a definite stricture has formed it is readily identified (Fig 104 1) as a small opening usually in the central field, with a pale circumference The latter stands out against the dark background of the deeper urethra.

Cystoscopy

The cystoscope consists of (*a*) a sheath containing the lighting system with a beak at the end which carries the lamp and (*b*) a telescope containing the

optical system The lamp is illuminated from a battery of 6 to 8 volts which is attached to the sheath by a flex

The bladder may be examined either in the dorsal or lithotomy position A sand bag not less than 8 inches high should be placed under the buttocks to tilt the bladder more into the horizontal position The penis is cleansed, and towels are placed around In some cases an anæsthetic is not necessary, but a local may be given as already described A low spinal anæsthetic is very satisfactory The instrument should always be tested immediately before use. The light is fixed at the necessary strength, the telescope thoroughly cleaned and the beak well lubricated In the female it is easily introduced once the external urinary meatus has been located The beak is dipped below the symphysis pubis and the urethra straightened In the male it is a more difficult procedure and requires considerable practice The penis is held up at right angles to the pubes, and the point of the cystoscope inserted into the meatus The instrument is then allowed to slide along the urethra almost by its own weight, care being taken that the beak points towards the roof as shown by the indicator or knob at the eye piece When the compressor urethræ is reached, progress is arrested The eye piece is now gently depressed often below the horizontal when the beak is found to slip past the triangular ligament into the prostatic urethra, and thence into the bladder The telescope is removed *and the faucet inserted The bladder is* irrigated with an antiseptic lotion. When the returning fluid is clear as seen when tested in a glass held up to the light, 6 to 8 oz. of lotion are introduced. If more fluid is used the illumination will not be so good The faucet is removed and replaced by the telescope the light is switched on and inspection begun.



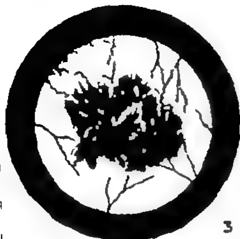
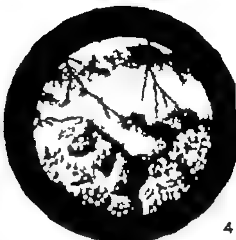





Fig 104

1 Well marked stricture of urethra
2 Numerous soft infiltrations of urethra
3 Papilloma of bladder
4 Two phosphatic stones in bladd
5 Carcinoma of bladder
6 Tuberculous cystitis.

optical system The lamp is illuminated from a battery of 6 to [illegible] volts which is attached to the sheath by a flex.

The bladder may be examined either in the dorsal or lithotomy position A sand bag not less than 3 inches high should be placed under the buttocks to tilt the bladder more into the horizontal position The penis is cleansed, and towels are placed around In some cases an anæsthetic is not necessary but a local may be given as already described A low spinal anæsthetic is very satisfactory The instrument should always be tested immediately before use The light is fixed at the necessary strength, the telescope thoroughly cleaned and the beak well lubricated In the female it is easily introduced once the external urinary meatus has been located The beak is dipped below the symphysis pubis and the urethra straightened. In the male it is a more difficult procedure and requires considerable practice. The penis is held up at right angles to the pubes and the point of the cystoscope inserted into the meatus The instrument is then allowed to slide along the urethra almost by its own weight, care being taken that the beak points towards the roof as shown by the indicator or knob at the eye-piece When the compressor urethræ is reached progress is arrested The eye piece is now gently depressed often below the horizontal when the beak is found to slip past the triangular ligament into the prostatic urethra, and thence into the bladder The telescope is removed and the faucet inserted. The bladder is irrigated with an antiseptic lotion When the returning fluid is clear, as seen when tested in a glass held up to the light, [illegible] to 8 oz. of lotion are introduced If more fluid is used the illumination will not be so good The faucet is removed and replaced by the telescope the light is switched on and inspection begun





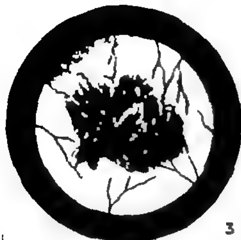








FIG 104

1 Well marked stricture of urethra
2. Numerous soft infiltrations of urethra
3 Papilloma of bladder
4 Two phosphatic stones in blad[illegible]
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6 Tuberculous cystitis.

optical system The lamp is illuminated from a battery of 6 to 8 volts which is attached to the sheath by a flex.

The bladder may be examined either in the dorsal or lithotomy position A sand bag not less than 8 inches high should be placed under the buttocks to tilt the bladder more into the horizontal position The penis is cleansed, and towels are placed around In some cases an anæsthetic is not necessary, but a local may be given as already described A low spinal anæsthetic is very satisfactory The instrument should always be tested immediately before use. The light is fixed at the necessary strength, the telescope thoroughly cleaned, and the beak well lubricated In the female it is easily introduced once the external urinary meatus has been located The beak is dipped below the symphysis pubis and the urethra straightened. In the male it is a more difficult procedure and requires considerable practice. The penis is held up at right angles to the pubes and the point of the cystoscope inserted into the meatus The instrument is then allowed to slide along the urethra almost by its own weight, care being taken that the beak points towards the roof as shown by the indicator or knob at the eye piece. When the compressor urethræ is reached, progress is arrested The eye piece is now gently depressed often below the horizontal, when the beak is found to slip past the triangular ligament into the prostatic urethra, and thence into the bladder The telescope is removed and the faucet inserted The bladder is irrigated with an antiseptic lotion. When the returning fluid is clear as seen when tested in a glass held up to the light, 6 to 8 oz. of lotion are introduced If more fluid is used the illumination will not be so good The faucet is removed and replaced by the telescope the light is switched on and inspection begun.

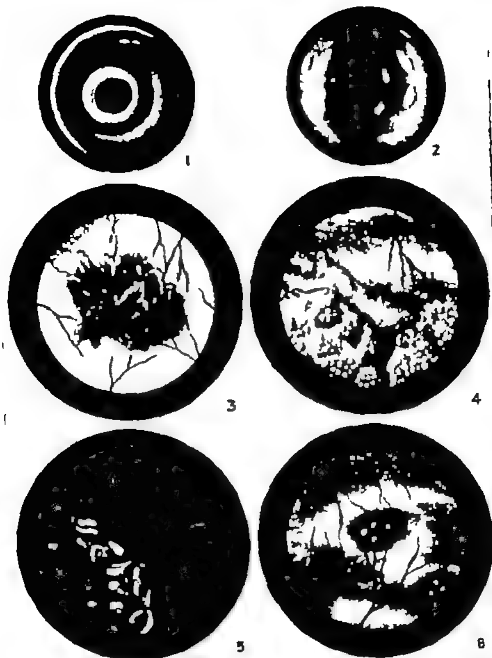


FIG 104

1 Well marked stricture of urethra
2. Numerous soft infiltrations of urethra
3 Papilloma of bladder
4 Two phosphatic stones in bladder
5 Carcinoma of bladder
6 Tuberculous cystitis.

There are three movements which can be imparted to the beak of the cystoscope These are (a) introduction and withdrawal (b) rotation, and (c) pendulum or see saw It is best to begin by examining the posterior wall and trigone since it is the most easily seen, and the part most commonly affected with pathological processes (Fig 105) The cystoscope is turned so that the indicator, and therefore the beak is pointing downwards—the six-o clock position It is then withdrawn until the internal urinary meatus is reached This is shown by the field becoming dark



FIG 105 —View of the interior of bladder showing trigone with internal meatus ureteric orifices, and inter ureteric bar

The cystoscope should now be introduced a short way and slowly rotated to one or other side The right or left ureteric orifice will come into the field at about seven and five o'clock Both openings should be inspected and also the area between them By employing a combination of the movements the whole of the posterior wall should then be examined This should be followed by an examination of the lateral walls and as much of the anterior wall as possible. The internal meatus should then be examined by a rotary movement of the instrument. The main indications for cystoscopy are

1 Hæmaturia in the absence of casts
2 Chronic cystitis
3 Suspected calculus or foreign body
4 Frequency of micturition, especially in the young
5 Enlargement of the prostate. In this condition it is always advisable to perform the examination as

an in patient, in view of the risk of precipitating acute retention

The most frequent pathological lesions are

1 Cystitis, which is shown by reddening and congestion of the mucous membrane with occasionally small ulcerations (Fig 104, 6)

2 New growths either villous papilloma or infiltrating carcinoma (Fig, 104 8 and 5)

8 Calculus, which may be single or multiple (Fig 104, 4)

4 Diverticulum

Care and Sterilisation of Instruments

All metal and rubber instruments can be sterilised by boiling Modern cystoscopes are also boilable but these can be adequately sterilised by immersion in oxycyanide of mercury 1 6,000 for 30 minutes Gum elastic instruments are in rather a different category The most satisfactory method of sterilising these is by formalin vapour This is the method of choice in institutions where these instruments are in daily use. There are however, reliable gum elastic bougies which can be boiled for one minute at a time up to thirty to forty times This is the method advocated when the use of these instruments is occasional. The boiling should be timed by a watch and on removing the instrument from the steriliser it should be immersed in cold oxycyanide solution, when it will be found to have regained its stiffness These instruments can also be rendered sterile by immersion for 30 minutes in oxycyanide of mercury 1 : 6 000 or biniodide of mercury 1 2,000 After use all instruments should be washed care being specially taken with hollow instruments to see that the lumen is clear Flushing under a tapered tap is the best method of effecting this The instrument should then be dried and resterilised

Complications of Instrumentation

Catheter Fever—After the passage of instruments along the urethra a certain proportion of cases develop fever and rigors This is due to the invasion of the blood stream by bacteria. If ordinary surgical precautions are taken their occurrence is limited to cases

in which there is already an infection of the urinary tract. The fever appears to depend on two factors—(1) the number of organisms in the urine, and (2) the degree of trauma produced It usually commences immediately after the first natural micturition following the instrumentation It manifests itself by a shivering attack, pyrexia, sweating, and a feeling of malaise. Rarely, septicæmia results from the infection

In the large majority of cases it can be prevented by (1) careful and gentle instrumentation and (2) adequate irrigation of the bladder either before or after instrumentation in all cases of infected urine.

Treatment—The patient should be kept warm, given urinary antiseptics and copious fluids The bacteræmia usually lasts for only a few hours

Hæmorrhage.—In a considerable proportion of cases there is a speck of blood after instrumentation, but in certain cases, especially when the surgeon has been rather vigorous, there may be a profuse hæmorrhage. This may also occur if the prostate is enlarged The patient should be kept at rest on a couch, and usually within half an hour most of the bleeding will have subsided He should be warned that there is likely to be some blood the next two or three times he passes water but that, provided he can pass water, there is nothing about which to be alarmed Rarely the bladder fills with blood and the patient develops a clot retention (p 241)

Injury to the Urethra.—There is always a minor degree of trauma in dilating a stricture. Occasionally in the passage of a metal instrument, when sufficient care is not taken the instrument perforates the urethra, and there have been cases when the tip of a sound or cystoscope has entered the rectum In such cases immediate cystostomy should be performed.

Stricture of the Urethra

A stricture is the replacement of the normal mucous membrane of the urethra by scar tissue It results from two causes—infection, which is much the commoner, and trauma The stricture is either single or multiple and in severe cases may affect the greater length of the canal. Certain strictures are easily dilatable, others are dense or cartilaginous and do not respond to this form of treatment.

Diagnosis of Stricture—The patient complains of difficulty in passing urine, that the stream is fine and sometimes that there is some alteration in its shape. The usual age period is 30 to 50 years There is not much increase in the frequency of micturition but there is usually a history of past urethritis or injury If a stricture is suspected a urethroscopy will make the diagnosis certain (Fig 104 1), but its presence may first be shown by obstruction to the passage of a moderate-sized instrument. When dealing with the stricture for the first time, it is advisable to use gum elastic bougies Urethroscopy will have given some indication as to the size of the lumen, otherwise this must be found by trial of different-sized instruments There are various methods of treating a stricture, but the two simplest are by intermittent or continuous dilatation

1 **Intermittent Dilatation.**—This, when applicable, is the method of choice Having passed an instrument, the stricture is dilated through a further four to five sizes A week later another treatment is given starting two sizes lower than the maximum previously reached The stricture is again dilated four or five sizes After reaching 20 French size with gum elastic instruments, metal bougies should be passed This course of treatment is pursued at weekly intervals until a full size is reached A good estimate of the latter is given by the external meatus The average-

sized urethra will take a 14 English or 20 French bougie When the stricture is fully dilated the period between treatments should be gradually extended, and by trial it will be found that this period may be from 1 to 6 months and sometimes even a year It is never wise to discharge a patient, although those cases which require to attend only at yearly intervals are probably cured

In a case where there are one or more false passages and considerable difficulty is met with in introducing an instrument a Harrison whip bougie (Fig 91) is of great value since the stricture can be dilated to a reasonable size by the one instrument

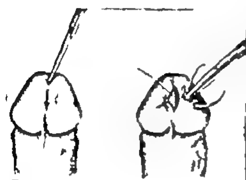
2 **Continuous Dilatation** —Occasionally it is found that the stricture will not dilate more than one or two sizes and in succeeding treatments no progress is made The patient is admitted to hospital and a gum elastic instrument is tied in (Fig 103) If the stricture is very narrow a fine bougie is used, and it will be found that micturition can occur alongside the instrument. The latter is changed daily and the stricture will usually dilate a few sizes each day An instrument of less size than the largest passed should be selected for tying in. When the lumen has reached a sufficient size a catheter is substituted for the solid instrument. If the stricture responds to this form of treatment, it is usually found that full dilatation is achieved in a week s time. The patient is subsequently treated by intermittent dilatation

STENOSIS OF THE EXTERNAL URINARY MEATUS

This is not uncommon in children, when it is either congenital or follows an injury to the glans at circumcision. In adults it is rarer and results from urethritis or a meatal chancre The treatment is simple, consisting of the production of a minor degree of hypospadias (Fig 106)

Under anæsthesia either local or general a tenotomy

knife is inserted in the pin hole meatus and the glans is cut in the mid line almost to the frenum The lips of the opening are everted on each side by a stitch which picks up the cut edge and the glans near the corona The meatus should be dilated daily for a fortnight with a pointed glass rod. In children this usually effects a cure, but in adults it is necessary to continue periodic dilatation



(a) (b)
Fig 106 —Meatotomy
(a) Insertion of tenotomy knife
(b) Everting stitch.

COMPLICATIONS OF STRICTURE

Acute Retention.—This may be the presenting symptom in the case it may occur from neglect in the continuation *of treatment on the part of the patient, or sometimes* from too forceful instrumentation. A considerable proportion of patients have increased difficulty in micturition for a period of 24 to 48 hours after the passage of bougies This is due to congestion of the urethral lining at the site of the stricture.

Treatment —An attempt should be made to pass an instrument. Gentleness and patience are of great importance. The position and approximate size of the stricture should be identified with the urethroscope or a moderate-sized bougie when dealing with a case for the first time It is advisable in the first instance to use only gum elastic instruments A small instrument should now be passed (8 French or 3 English) If this should pass comparatively easily further instruments should be passed in series to 11 or 12

French or 0 English and a catheter passed, tied in, and the bladder emptied

If a No 8 French instrument cannot be passed, Nos 1, 2 and 3 French filiform should be tried By introducing three or more filiform bougies and manipulating each in turn, with patience one of them can often be made to pass the stricture (Fig 107) If one is successfully passed it should be tied in and it will be found that urine drips alongside it, gradually relieving the distension In dealing with a narrow stricture it is always wise to be satisfied with the passage of even a small instrument and the operator should not be encouraged to attempt bigger and better things since after the removal of the small bougie it may be impossible to introduce any other instrument If the size of the stricture is known from previous recent instrumentation an olivary tipped catheter one to two sizes smaller than the stricture should be introduced If the passage of an instrument is found to be impossible, drainage of the bladder must be established in some other way This can be done either by external urethrotomy which though difficult is probably the better method or by supra



FIG 107.—The "faggot method" of using filiform bougies in the endeavour to pass through a narrow stricture

Acute Retention of Urine

Mechanical Obstruction

1 In lumen of urethra,	(a) calculus
	(b) foreign body
2 In wall of urethra,	(a) urethritis
	(b) stricture
	(c) meatal stenosis and phimosis
	(d) rupture
3 Pressure from outside	Tumours impacted in the pelvis
4 Prostatic obstruction,	(a) Simple enlargement
	(b) Fibrosis
	(c) Abscess
	(d) Calculus
	(e) Carcinoma
5 Bladder conditions,	(a) Clot (blood)
	(b) Calculus
	(c) Growth

Non mechanical

1 Reflex—post-operative.
2 Pathological nervous disease
3 Hysteria

When acute retention develops the patient is in severe pain which spasmodically becomes worse

Examination—A careful history should be taken and the duration of urinary symptoms noted. He should be asked about previous frequency, especially nocturnal, difficulty, and delay and whether there has been any hæmaturia stone, or gravel He should be questioned as to the incidence of venereal disease, either old or recent. It will frequently be found that the patient has held his water too long owing to some social obligation or that he has been guilty of excess in alcohol coitus or exercise He should be questioned as to the state of his bowels and his appetite, and

whether or not there has been any recent increase in thirst

The abdomen is inspected A rounded swelling rising from the pelvis can often be seen and always palpated It is tender on pressure and dull to percussion Look at the tongue—if it is moist and clean, the renal function is probably good Examine the external genitals for evidence of urethritis or hæmaturia Palpate the perineum when a thickening will indicate the presence of a stricture Atrophy of a testis will suggest an old syphilitic infection The pupils and their reaction, together with the responses of the deep reflexes should be noted Rectal examination with a gloved finger should be made. The prostate is normally flat, smooth, and firm and the median groove between the two lobes is just appreciated In simple enlargement one or both lobes may be felt as a rounded smooth projection into the rectum This is elastic to feel and the mucous membrane moves easily over it The gland is movable, and the median groove is more prominent. In carcinoma one or other of the lobes is hard and irregular, and can be felt fixed to the lateral wall of the pelvis If the prostate feels boggy or soft and tender, there is an acute prostatitis or abscess

Treatment —Prostatic obstruction an attempt should be made to pass a catheter A No 18 French (8 English) coudé should be well lubricated and gently introduced A No 18 or 20 Tieman's catheter (Fig 92) is often easily passed and may of course be sterilised by boiling If this fails a bi-coudé of the same size should be tried No force should be used, since the prostate is very congested and the catheter may easily penetrate its substance, producing a false passage and causing considerable bleeding Method gentleness and patience are of the utmost importance If unsuccessful, smaller sizes of bi-coudé should be tried and it may help to soften one in some warm lotion, or

alternatively, to thread a curved wire introducer into the catheter Finally if all these fail, an attempt should be made to pass a metal instrument with a larger curve, the so-called prostatic catheter

In the majority of cases an instrument can be passed If the retention is only of a few hours duration, and general examination shows no evidence of renal insufficiency, the bladder can be emptied If instrumentation is easy the catheter should be removed and if necessary reinserted later If, however, instrumentation is difficult, or the patient very intolerant, it is better to tie the catheter in for 48 hours (Fig 108) A metal catheter should not be left in the urethra.

Stricture—See p 282

Failure to Pass an Instrument.—If the patient is not very uncomfortable, it may be advisable to give morphia, gr ¼, a belladonna suppository or pethedine, and trying the effect of a hot bath Should this fail, or the condition be urgent, then supra pubic drainage must be performed The method of supra pubic puncture of the bladder with a needle or small trocar and cannula is advocated by some surgeons This is not free from

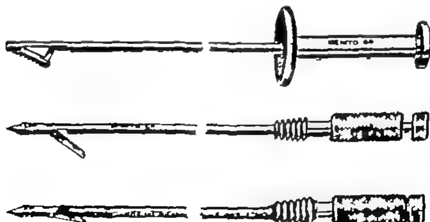


Fig 108 —Riches supra pubic tube and introducer

danger, since, unless the obstruction is relieved very soon afterwards, there may be leaking through the puncture and consequent extravasation of urine, followed by a para vesical and pelvic cellulitis A method introduced by Riches has greatly lessened the risk He uses an introducer with a retractable knife at the end (Fig 108) The method is simple and, provided the direction of introduction is obliquely downwards, there is little danger of untoward damage, and decompression can be obtained better by this method than by a formal cystostomy It is, however, safer to expose the bladder through a small supra pubic incision and insert a self retaining tube either through a stab wound or through a large trocar Self retaining tubes are of many types those most commonly in use are the de Pezzer Malecôt, or White s

Supra-pubic Cystostomy—The supra pubic region is shaved and the skin is prepared The patient is anæsthetised An incision, 1 to 2 inches long depend ing on the obesity of the patient, is made in the mid line through the skin and subcutaneous tissue down to the rectus sheath This is divided in the mid line, and the two muscles separated. The pre vesical fascia is carefully incised horizontally and the peri toneum stripped up from the bladder by gauze dis section The bladder is easily identified by the large tortuous veins which run in a vertical direction on its anterior surface. The organ is now fixed with a tissue forceps, a stab made, and a tube inserted on a straight introducer The wound is closed around the tube and the latter is fixed to the skin with a stitch

Clot Retention—This is usually due to vesical or prostatic hæmorrhage, but may result from too violent instrumentation of the urethra. A catheter should be passed, a syringe is attached to the end of the catheter, and by alternately aspirating and intro ducing an ounce or two of lotion, an attempt should be made to clear the bladder A Bigelow's [illegible]

is extremely useful in this emergency If the bladder cannot be emptied by these means a cystostomy must be performed and the clot removed

Retention from bladder stone or growth should be relieved by catheterisation and the cause subsequently treated

Acute Urethritis—Retention occasionally occurs in acute urethritis This is usually due to spasm rather than obstruction An anterior irrigation should be given with a weak solution—1 10 000 of potassium permanganate. The temperature of the lotion should be 100° to 105° Fahrenheit An attempt is now made to run the lotion into the posterior urethra If this succeeds, the patient can then usually pass urine normally If this fails a soft rubber catheter 7 or 8 English, must be passed

Prostatic Abscess.—A catheter should be passed This is usually quite easy and frequently the passage of the instrument causes the abscess to burst into the urethra, and thus natural drainage is established

Impacted gravid uterus, fibroids etc., should be relieved by catheterisation, and the cause dealt with at a later date.

Non-obstructive Retention.—This occurs frequently after certain operations, such as hæmorrhoidectomy excision of fistula in ano excision of rectum, repair of hernia, and gynæcological conditions It is believed to be reflex in origin. Hot applications should be applied to the hypogastrium, the patient encouraged and the following mixture administered

Pot cit.	gr lx
Tinct. hyoscyam.	♏ xx
Tinct. belladonna	♏ x
Infus Buchu	ad ℥i

This frequently produces relief If it fails 1 c.c. of Moryl (carbachol) should be given subcutaneously In

over 70 per cent of cases, the patient voids urine normally within an hour If these methods fail a soft rubber catheter is introduced and the bladder emptied

Chronic Retention.—This is usually due to prostatic obstruction, but also occurs in certain diseases of the central nervous system There is always a lengthy history of difficulty of micturition The tongue is dry and furred The patient looks toxic and complains of thirst There is frequently an overflow incontinence as shown by his wetting the bed at night, and his trousers through the day In these cases, the bladder must not be immediately emptied, but should be decompressed very slowly The sudden release of back pressure on the kidneys may lead to renal hæmorrhage or anuria If possible, the patient should be encouraged to drink six pints of fluid in the 24 hours, and a watch is kept on the rate of emptying by frequent palpation in the supra pubic region Complete emptying of the bladder should be accomplished in 2 to 3 days As soon as possible a blood urea estimation is made and if this is greatly raised or if the patient is showing signs of uræmia as exhibited by restlessness, great thirst, and diminished output, intravenous drip infusion of 5 per cent. glucose, or isotonic sodium sulphate (4 285 per cent.) should be given

Hydrocele of the Tunica Vaginalis

Fluid accumulates in the tunica vaginalis in association with well recognised conditions—the symptomatic hydrocele. More frequently this occurs without any recognisable cause—the idiopathic hydrocele. It may be either acute or chronic.

Acute Hydrocele.—This is usually symptomatic and occurs as a result of (1) inflammation of the testis or epididymis, (2) new-growth of the testis, (3) direct trauma, (4) injury to the spermatic cord as, for example, after operation for varicocele or torsion

Chronic Hydrocele.—This may follow the a
phase, but in the majority of cases there is no ob
causative factor

On examination there is a fluctuant swelling w
is pyriform in shape The swelling, when s
is confined to the scrotum but if large invade
inguinal canal *The spermatic cord can be fe*
be normal in size and consistency above the swel
In acute cases there may be tenderness but as a
this is due to the underlying cause. The swelling
be found to transilluminate.

Treatment (a) *Palliative*—This takes the for
intermittent tapping with a trocar and cannula
dictum of the ship s captain (in less technical langu
was that there were two kinds of swellings in
scrotum "those that were tapped and produced w
did well, but those that were tapped and prod
fæces did badly ' The swelling must therefore alw
be transilluminated Besides confirming the diagn
this will show the position of the testis, and there
the part to be avoided with the trocar The sk
cleaned with spirit and the hydrocele rendered t
by compression with a hand in its upper p
Several veins will be seen to stand out just below
skin. Avoiding these, a small, sharp trocar and cann
is rapidly pushed into the hydrocele The troca
withdrawn and the hydrocele is allowed to emp
this being facilitated by pressure with the hand
the scrotum The cannula is then withdrawn
pressure applied to the opening for a few mome
As a rule, it is not necessary to apply any dress
but if there is a slight venous ooze, a wisp of w
and collodion may be applied

(b) *Injection*—The treatment of hydrocele by
jection is very old, dating from the second centu
A large number of solutions have been used includ
red wine, port wine, caustic potash, sea water m
tannin, and iodine. At the present time, quin

and urethane, and sodium morrhuate are the commonest employed The former is probably the better of the two, and it causes less pain

Technique —The skin of the scrotum is prepared as for tapping A point is selected in the upper portion of the hydrocele in the least vascular part. A 2 to 3 inch needle (10 gauge) is inserted well into the sac, and the contents aspirated with a 20-c.c. syringe. Care must be taken to empty the sac, and to prevent the point of the needle from slipping out When the hydrocele is completely emptied 3 to 4 c.c. of quinine hydrochloride and urethane is injected The needle is withdrawn and the opening is sealed with a wisp of cotton wool and collodion

In practically every case, there is a sharp attack of pain which lasts for about a minute. The pain is usually in the lower abdomen, on the side of the injection In dealing with a moderate-sized hydrocele a suspensory bandage should be fitted Fluid soon reaccumulates—often more than the original amount —and at the end of a week, a further injection is given in a similar manner Two subsequent injections should be given at three-weekly intervals If the hydrocele is not then cured it is unlikely to respond to further treatment by this method The advantages of the sclerosing injection are, that it is simple and that it avoids institutional treatment. It causes considerable pain and in a small percentage of cases it is complicated by epididymo-orchitis It is uncertain in its result and is only applicable to small and moderate sized swellings It should not be used in secondary or congenital hydroceles

(*c*) *Radical Cure* —This should be advised in the majority of cases The scrotum and pubic region are shaved and the skin is cleaned A short incision is made, either in the groin upwards and outwards from the pubic spine, or in the scrotum The arguments raised against the latter incision are that the wound

takes longer to heal, and is more easily soiled In practice, however, it is satisfactory, and allows of more accurate hæmostasis The hydrocele sac, having been exposed is pressed into the wound, and opened with a scalpel, the contents being collected in a receiver The edges of the tunica are now grasped with forceps, the sac and testis are pulled out of the wound and carefully dissected from the surrounding tissues All bleeding points are picked up and ligated This is very important, as owing to the lax nature of the scrotal tissues, veins will continue to bleed and may form a large hæmatoma. The tunica vaginalis, being now fully exposed, can be dealt with in either of the following ways

(1) If small and especially if thin walled the best method is *to evert the testis through the hole in the tunica* and fix the latter in this position with a few sutures on the posterior aspect of the cord and epididymis

(2) If the parietal tunica is large and bulky most of it should be removed This is quite easy, but there are numerous vessels in the membrane and these bleed freely If the line of section is almost flush with the visceral part, it is advisable to underrun the cut margin with a continuous stitch *It is usually easier* to leave about ½ inch of parietal tunica on each side and then approximate and stitch the two edges with a continuous suture behind the spermatic cord and epididymis.



FIG 109 —Operation for hydrocele The testis has been invaginated and the edges of the tunica are sutured behind the epididymis.

The testis is now returned to the scrotum, a piece of corrugated rubber being inserted and left in for 24 hours The wound is closed, and if the incision has been made in the scrotum it is more comfortable for the patient to employ catgut as suture material

VARICOCELE

This is a comparatively common condition and is much more frequently found on the left side. In the large majority of cases no cause can be found for the condition Rarely a tumour of the kidney, a carcinoma of the recto-pelvic junction or a retroperitoneal sarcoma may cause obstruction to the venous return and produce a comparatively acute varicocele. In these cases the patient frequently notices the swelling, but otherwise the condition is mainly symptomless and is usually discovered at routine examination

Operation for symptomless varicocele is entirely unjustifiable. Even when the condition is giving rise to symptoms, if these are carefully analysed, it will be found that they are mainly of a psychological nature The fear of impotence is not uncommon, as is the belief that sexual excess has played a big part in the development of the condition If explanation and suggestive treatment prove of no avail, and especially if the scrotum is very pendulous or the patient is prevented from entering one of the services then it is probably advisable to treat the condition by operation This is quite a simple procedure.

Operative Treatment.—The pubic region is shaved and cleaned A short incision is made upwards and outwards from the pubic spine, and the spermatic cord is exposed throughout its length between the scrotum and the external inguinal ring It is not necessary to open the inguinal canal. The cord is gently lifted out of its bed and its surrounding fascia, together with the cremaster muscle, is divided longitudinally The pampiniform plexus is now seen, and

the vas deferens is identified as it lies behind the main mass of vessels It can be felt as a firm cord like structure between the finger and thumb The vas, *together with its artery and several venules of the* plexus should be carefully separated It is important to leave adequate veins with the vas since, if this is not done, hydrocele of the tunica vaginalis or atrophy of the testicle is apt to develop The spermatic artery should also be identified and preserved The main mass of veins is now gently separated from the other structures for a distance of 2 to 3 inches This may be longer in a very pendulous scrotum. The plexus is ligated at the upper and lower limits of the *cleared portion The intervening mass is removed,* care being taken not to cut too near the ligature in case the latter slips A further ligature is applied to each cut end and the last two ligatures are tied to each *other and thus sling* up the testis. The coverings of the cord are reunited by two or three sutures and the wound is closed (Fig 110)

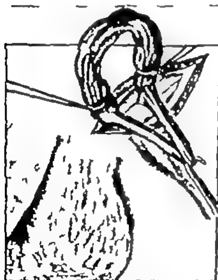


Fig 110—Operation for varicocele. Note the veins left along side the vas.

The patient should be *kept* in bed for 5 or 6 days, and when allowed up must wear a suspensory bandage for some weeks

SPERMATOCELE

This is a cystic condition occurring in association with the testis or epididymis. It is usually met with in elderly men and is then a reten

tion cyst in one or more of the tubules of the mediastinum testis and epididymis It occurs less commonly in young males from degeneration of vestigial structures or partial failure of the urogenital union There are usually several cysts and these are found most often at the upper and back part of the testis, but may occur anywhere in the epididymis The size varies from that of a pea to a hen s egg and characteristically they are rounded translucent swellings

Treatment —When small, they rarely give rise to symptoms and therefore require no treatment. When large, they may be treated by intermittent tapping or by excision Cysts may recur after the radical operation Excision is quite easy, and should be done through an incision similar to that employed in the treatment of hydrocele It is usually necessary to incise the tunica vaginalis, and in this case the testicle should be inverted through the opening as in the cure of hydrocele. The thin walled cyst is carefully dissected from the surrounding epididymis and all bleeding points are caught and ligated The wound is closed a piece of corrugated rubber drain being left in for 24 hours

FOREIGN BODIES IN THE URETHRA

These may be divided into three main groups

(a) Fragments of instruments, such as catheter or bougie accidentally broken off and left behind.

(b) Foreign bodies introduced by the patient. These are of infinite variety and include pencils, crayons wax tapers, pins needles, grass, etc. They are usually inserted for masturbatory purposes, but occasionally in children out of curiosity

(c) Calculi which have passed from the bladder or prostate

As elsewhere when a foreign body is impacted in a mucus lined canal, extraction by the natural passage

is the method of choice, if this can be carried out without producing serious injury The extraction may be rendered urgent by the presence of retention of urine, repeated hæmorrhages, intense pain or swelling of the penis and perineum indicating extravasation It is rarely justifiable to wait for spontaneous natural expulsion The line of treatment, therefore, is quite clear First, try to remove the foreign body by the natural passage, and if this proves impossible, perform an external urethrotomy

The Removal of Smooth or Cylindrical Objects.—The following simple plan should first be tried

Compress the meatus between the finger and thumb *and ask the patient to attempt to pass water* *When* the urethra appears well distended, release the *pressure and occasionally the rush of fluid will expel* the object. If this fails, manipulation by milking should be tried It is important, however, in doing this, to fix the object and prevent its passage towards the bladder by pressure with a finger or thumb immediately behind the foreign body If these methods fail, a urethroscope should be passed and an attempt made to seize the object with urethral forceps, hook or curette

Removal of Rough or Irregular Objects.—If these are dealt with by manipulation, considerable injury may be caused to the urethra. They should therefore be removed with forceps through a urethroscope or urethral speculum

Removal of Sharp Objects.—Ordinary pins or hair pins are usually introduced head or loop first. The point is therefore directed towards the meatus Any attempt to extract the object by external manipulation or blindly with forceps will merely bury the point more deeply and cause further laceration. They should therefore be removed under direct vision and it is better to attempt this method first. If it fails, version is a sure and easy method although it

causes bleeding and some injury to the wall of the urethra (Fig 111(*a*))

Method of Version —The head of the pin is felt by

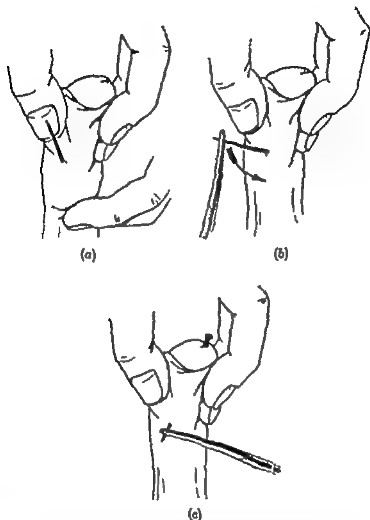


FIG 111 —Removal of pin from urethra.

(*a*) Forcing point of pin through wall of urethra and body of penis. (*b*) Seizing point with forceps. (*c*) Rotation.

the tip of the index finger of the left hand The penis is bent at the position where the point is embedded and pressure is applied to the head This

forces the point through the urethra substance of the penis and skin A forceps is now applied to the protruding point (Fig 111(*b*)), which is rotated until the head points towards the meatus With a little pressure accompanied by threading of the penis, the head emerges (Fig 111(*c*)) and the pin is easily extracted A needle may be dealt with in much the same way, but it can be extracted after the point has been made to protrude through the wall of the penis

Calculus Impacted in the Urethra.—The commonest sites for impaction are (*a*) in the prostatic urethra just behind the triangular ligament, (*b*) at the fossa navicularis, and (*c*) at the external meatus A stone may be impacted anywhere in the anterior urethra behind a stricture.

The patient usually presents himself with a history of a sudden, severe stabbing pain in the urethra There may or may not be retention of urine.

Treatment —A stone at the external meatus can be seen or felt. It should be lifted out with a pair of forceps If farther down the penile urethra, the man œuvre of compressing the meatus and attempting to flush the stone out on a gush of urine should be tried. When dealing with small or elongated calculi when there is some space between them and the urethral wall an attempt should be made to extract with suit able forceps or a curette. In the presence of a stric ture an external urethrotomy is necessary If the stone is in the prostatic urethra, a metal bougie should be passed and this will usually push the stone back into the bladder from where it can be subsequently removed After relieving the urgent symptoms the patient should be investigated for evidence of lithiasis elsewhere in the urinary tract.

PHIMOSIS

1 **Circumcision in an Infant.**—The penis is cleansed with soap and water The tip of the foreskin

is grasped on each side by Spencer Wells' forceps, and enough traction is made to permit a probe being introduced for the purpose of separating adhesions between the glans and the foreskin For success with this method this step of the operation is of paramount importance Exercising traction on the now freed prepuce, bone forceps are applied with their V shaped surface towards the glans After applying pressure for three minutes, the superfluous tissue is severed with a sharp scalpel just distal to the instrument There is no hæmorrhage, and the skin and mucous membrane are sealed by the pressure throughout the circumcision. What remains of the foreskin is gently placed behind the corona with a probe. A wisp of wool soaked in tinct. benzoin co is the only dressing required

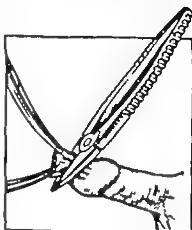


Fig 112.—Circumcision using bone forceps.

2 **Circumcision in a Child.**—The prepuce is drawn well forwards, and a sinus forceps is applied to it, at an angle, distal to the glans (Fig 113) Care must be taken to exclude the latter With a sharp pair of scissors, the prepuce is cut off along the distal side of the forceps. The cut skin edges now retract, and the mucous membrane is gently freed from the glans It may be necessary to excise a further small amount of the

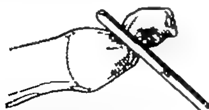
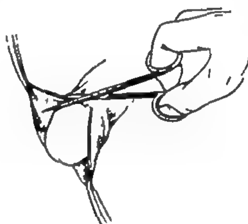


Fig 113 —Circumcision in a child Line of application of forceps

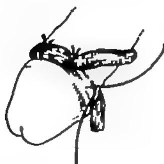
mucous part The cut mucous and skin edges are now sutured together with a continuous No 0000 catgut A ribbon-gauze dressing dipped in Friar's balsam, or flavine and paraffin, is wrapped round the wound, and a sundry applied After 2–3 days the dressing should be allowed to soak off in a bath It is important to avoid injury to the glans, and the removal of too much prepuce



(a)



(b)



(c)

Fig 114.—Circumcision in an adult

(a) Infiltration of prepuce with local anæsthetic. (b) Excision of prepuce. (c) Anchor dressing

3 **Circumcision in an Adult**—This can be performed under local anæsthesia A ring is infiltrated with 1 per cent novocaine just proximal to the level of the corona (Fig 114(*a*)) The needle is then inserted at the muco-dermal junction in the mid line dorsally and the skin infiltrated down to the ring Along this line the prepuce is cut with scissors to within ½ inch of the corona (Fig 114(*b*)) The cut edges are held up with forceps and the prepuce is cut away All bleeding points are picked up and ligated The edges of the skin and mucous layers are reunited with interrupted sutures of No 0 catgut The ends of each suture are left long and are used to anchor a dressing of ribbon gauze dipped in Friar's balsam or flavine (Fig 114(*c*)) It is advisable for the patient to remain in bed for 2 to 3 days, and he should be given pot. brom gr xv t.d.s. to diminish the tendency to erection The dressing can be removed in seven days

PARAPHIMOSIS

When a tight prepuce is pulled back over the glans and allowed to remain there, it produces a constriction



FIG 115A.—Manual reduction of a paraphimosis.



FIG 115B.—Cutting the constricting band.

which causes progressive œdema of the glans and prepuce. In severe degrees, the swelling is enormous, and it is difficult to distinguish the constricting band The paraphimosis must be reduced, and this can usually be done by manipulation

Technique—It may be necessary to administer an anæsthetic. A piece of white lint, dipped in normal saline, is wrapped round the penis so that only the glans is protruding The body of the penis is gripped in the left hand, and the right thumb pushes firmly on the glans (Fig 115A) when reduction should occur

If manipulation fails, the constricting ring must be severed with a scalpel (Fig 115B) This may be by no means easy on account of the œdema After reduction, the glans and prepuce are irrigated with normal saline, three times per day, and dusting powder applied until the swelling has subsided. The penis must also be supported

Balanitis

Inflammation of the glans may follow trauma, or infection in the presence of a phimosis There may be an accompanying epithelioma, chancre, or chancroid. If the prepuce is very tight, it is necessary to perform a dorsal slit in order to provide adequate drainage An uncomplicated balanitis readily clears up The part should be gently irrigated three or four times per day with a normal saline solution followed by the application of dusting powder

Preputial Warts

These are not uncommon and are usually multiple They appear as small papillomata, usually at the corona, but may be on the prepuce or glans The meatus should always be inspected The wart is destroyed by applying a small crystal of trichlor acetic acid on a fine probe

Epididymo Orchitis

This is either acute or chronic. The acute is usually caused by infection with the gonococcus, coliform bacillus, or staphylococcus the chronic by the tubercle bacillus The acute condition is very painful, and is frequently accompanied by marked general symptoms such as malaise, anorexia, and pyrexia

Treatment—The patient should be put to bed The scrotum is supported either with pad or a sling of strapping between the two thighs. Heat, in the form of antiphlogistine or hot bottles, or cold, in the form of an ice-pack, should be tried The pain is usually eased by one or other of these Sulphanil amide should be administered After a few days the condition begins to improve. A suspensory bandage should be worn until the inflammation has completely subsided In a small number of cases an abscess will form This will require drainage through a small incision

CHAPTER XI

THE EYE, EAR AND NOSE

Foreign Bodies in the Eye—The ocular conjunctiva and cornea should be carefully examined, a lens being used if necessary. It is often possible to see a foreign body embedded in the cornea by looking obliquely at the latter when direct vision has revealed nothing. When a foreign body is present, 4 per cent. cocaine solution should be dropped into the eye the patient being seated with the head thrown backwards. After two minutes the cocaine drops are repeated. The globe is then fixed by gentle pressure with the left index finger through the lower lid, and an attempt is made to brush off the intruder with cotton wool wound



Fig 116.—A spud.

around a glass rod. If this fails the foreign body must be displaced with a spud or a discission needle. If the foreign body is embedded in the cornea a needle should be used as a spud is apt to cause an extensive abrasion. Care must be taken not to perforate the cornea. Sometimes a little rust remains after the removal of a steel chip and should not be touched. Acriflavine emulsion (1 2000) or castor oil is introduced and a pad of gauze bandaged over the eye for 12 hours. Severe irritation calls for the application of atropine ointment.

If no foreign body is seen on the cornea or the ocular conjunctiva, the palpebral conjunctiva should

EPIDIDYMO ORCHITIS

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sulted It should be remembered that a central corneal scar seriously affects vision

A course of chemotherapy is often useful in the treatment of a corneal ulcer, especially if the condition is associated with infection of the conjunctival sac

Burns—These are often due to lime or strong acids, and all require similar treatment namely the instillation of olive oil, castor oil, paroleine, or cod liver oil. An anæsthetic is given and any remaining foreign bodies removed, after which more oil is instilled, and a pad and bandage are applied A very guarded prognosis should be given on account of the probability of corneal opacities and symblepharon, but the risk of adhesions is minimised by the daily passage of a probe between the ocular and palpebral conjunctivæ.

Acute glaucoma is a condition which requires immediate diagnosis and prompt treatment In some cases vomiting is a prominent symptom in which case an unwary clinician may consider the patient to be suffering from some abdominal condition associated with a " cold in the eye "

Acute glaucoma most frequently occurs in the evening, and is ushered in with severe periorbital pain, which is sometimes associated with nausea or vomiting On examination the cornea appears greyish green in colour and circumcorneal congestion is apparent Palpation of the globe through the upper lid reveals a rise of intraocular tension Emergency treatment consists in the instillation of eserine (one per cent in castor oil) This is repeated three times during the first hour and then at hourly intervals until either tension subsides or operation is performed The application of heat or short wave diathermy helps to relieve pain As in the case of increased intra cranial pressure the intravenous injection of some hypertonic solution such as glucose (100 c.c. of fifty per

cent), is often beneficial in reducing intraocular tension

If these measures fail then operative treatment will be required and either the sclera is trephined or iridectomy performed During the preliminary stages of treatment, eserine should be instilled into the opposite eye in order to prevent it from becoming similarly afflicted

Penetrating Wounds of the Eye—If the *cornea* is involved with prolapse of the iris, the latter should be pushed back with a fine probe after the conjunctival sac has been well washed out with boric lotion If the wound is peripheral, eserine should be instilled, and if central, atropine

When the iris cannot be replaced, 2 per cent cocaine solution should be instilled, and the prolapsed portion gently drawn out with very fine forceps and cut off with iridectomy scissors Atropine is instilled and if the iris is adherent to the wound, it should be freed with a fine probe Should iritis supervene, atropine and hot fomentations are employed

Wounds of the *sclerotic and conjunctiva* call for the usual thorough washing out of the conjunctival sac with boric lotion If sufficiently extensive they are stitched with fine silk A pad and bandage should be worn

Wounds of the *dangerous region* of the sclerotic i.e within ¼ of an inch behind the sclero-corneal junction, may be complicated by cyclitis particularly if there is any prolapse of the ciliary body Owing to the great danger of sympathetic ophthalmia, wounds of this region, accompanied by loss of sight to the extent of only perception of light remaining, should be treated by immediate excision of the globe Excision should also be considered if the eye remains inflamed and painful.

The remaining injuries of the eye for which excision is indicated are

1 Rupture of the globe Tension is lost and excision remains the only treatment

2 Compound dislocation of the lens

3 Injuries, in which loss of sight has or definitely will occur especially if the eye is painful

4 An irremovable foreign body or one the removal of which would totally destroy vision

Excision of the Eyeball.—In cases which are not urgent a culture should be taken from the conjunctival sac, and infection, if present, suitably treated A *general anæsthetic* is administered or in the case of a placid patient cocaine will be sufficient The patient is in the supine position and the surgeon stands behind the patient's head The speculum is introduced and widely opened the conjunctiva then being picked up with forceps and divided just behind the sclero-corneal junction This division is continued all round, after which Tenon s capsule is opened and a strabismus hook inserted under the external rectus muscle which is divided with scissors the remaining three recti muscles being similarly treated When the speculum is pressed backwards, the globe will project forwards and blunt pointed scissors slightly curved on the flat are passed well back on the inner side of the optic nerve which is divided The eyeball is now drawn forwards with a finger and the oblique muscles and any remaining tissues divided close to the globe which is removed The socket is irrigated with hot saline and pressure applied by bandaging a pad of gauze firmly over the closed lids.



FIG 117 —Excision of globe. Speculum in position and globe is steadied by fixation forceps.

THE EAR

Foreign Bodies in the Ear—Small objects, such as buttons or beads, are not uncommonly introduced by children especially when they are warned not to do so! Deafness occurs followed by a purulent discharge Ceruminous plugs occasionally form in the external ear, and often rapidly swell after bathing owing to absorption of moisture Deafness follows, and if the meatus is completely blocked tinnitus and even vomiting may occur

Attempts to remove the wax or foreign body are made by syringing the ear the stream of mildly antiseptic lotion being directed along the upper wall The lotion must be between 90° and 100° F otherwise unpleasant though transient giddiness is likely to occur A few drops of liquid paraffin instilled 10 minutes before syringing will soften a hard plug of wax. If this fails a speculum and a small blunt hook may be used, and an anæsthetic is required in the case of a fractious child If a foreign body is tightly impacted, and other methods fail, a mastoid incision is made and the auricle displaced forward so as to facilitate removal

Hæmatoma of the auricle is apt to result in unsightly deformity if ignored an extreme example being the "cauliflower" ears of pugilists In addition infection is apt to supervene unless the blood is evacuated In early cases the fluid blood can be aspirated with a syringe and a wide bore needle after which strapping is firmly applied in order to prevent further oozing If more than a few hours have elapsed a small incision is necessary through which clot and serum can be expressed

Rupture of the Drum.—Is sometimes due to the barbarous practice of "boxing the ear" loud explosions or attempts to remove foreign bodies by the unskilled It is a common complication of fracture of the base of



3 Examination of the drum shows perforation or swelling if the middle ear is inflamed In cases of otitis externa the introduction of a speculum causes pain, and the drum is either normal or only slightly congested

Acute Otitis Media.—This condition usually extends along the Eustachian tubes from the naso pharynx, and therefore commonly follows diphtheria, tonsillitis, etc. Œdema around the orifices of the tubes causes retention of secretion in the middle ear, which further predisposes to infection The condition occasionally extends from the external ear through a perforation or rent in the tympanic membrane, and may also arise as a blood borne infection in which case the pneumococcus is commonly the causative organism

The patient complains of severe pain deafness, or tinnitus and vomiting may occur in young children Post-auricular œdema is common (*vide supra*) If an abscess forms over the mastoid process the auricle is displaced forwards as the pus is beneath the periosteum This sign distinguishes a mastoid abscess from suppuration of the post auricular glands Constitutional symptoms and signs of infection are present

Treatment consists in the application of warmth, attempts to relieve congestion around the Eustachian orifices by astringent nasal sprays confinement to bed, and the administration of a sulphonamide preparation such as sulphadiazine Four tablets (2 g) are given immediately, and two tablets at four hourly intervals for twenty four hours following which 1 tablet is given every four hours until the temperature remains normal for twenty four hours The majority of cases abort under this regime but progress must be watched by frequent aural examinations The temperature may fall to normal an symptoms abate although the middle ear is full c

pus If the drum bulges, or if pain persists, then the drum should be incised in order to relieve tension and provide drainage

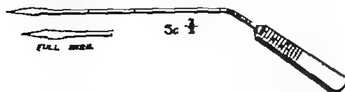


FIG 118.—A myringotome.

MYRINGOTOMY requires a general anæsthetic and a good light The meatus is cleansed with mild antiseptic, and the bulging drum is seen through a speculum, reflected light being used for illumination The tympanic membrane is incised with a myringotome the lower and posterior quadrant being selected, which allows easy drainage, and avoids injury to the chorda tympani nerve (Fig 119) Mucopurulent fluid escapes and relief is immediate provided that an adequate incision has been made Fomentations are continued for 2 or 3 days, and the discharge rapidly becomes serous and ceases in about a week. This minor operation should be performed more frequently than is customary in order to relieve symptoms, prevent mastoiditis, and obviate the ragged hole which results if pus is allowed to erode the drum

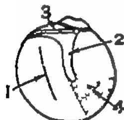


FIG 119—1 Line of incision. 2 Malleus. 3 Chorda tympani nerve 4. Shrapnell's membrane

THE NOSE

Foreign bodies are a common cause of unilateral discharge in children who should not have access to small objects which they can introduce into natural orifices Frequently there is no history obtainable of the introduction and a small child may be quite

unaware of its misdemeanour Once the foreign body is lodged in the nostril, œdema of the adjacent mucosa results in impaction As the foreign body is nearly always in the inferior meatus it may be seen on direct inspection if the nose is tilted upwards Otherwise the introduction of a Thudichum's speculum reveals its presence

The time honoured practice, so frequently advocated in successive editions of surgical books, of syringing fluids through the opposite nostril is to be deprecated The procedure is frightening for a child of tender years, and is most unlikely to disimpact the object Moreover, as infection has probably supervened contaminated fluid is likely to be forced along the Eustachian tubes or into accessory nasal sinuses Under local or general anæsthesia, according to the amenability of the patient a bent probe or Eustachian catheter is gently passed along the middle meatus When the point of the instrument is felt to be behind the object the handle of the instrument is tilted upwards and gentle manipulation disimpacts and delivers the foreign body

Fracture of the nasal bones results in unsightly deformity either from depression or lateral deviation unless reduction is meticulous Also associated fracture of the septum is a common complication, and unless this is corrected unilateral nasal obstruction will result and the patient may be condemned to a submucous resection at a later date

Reduction of the fracture should be accomplished as soon as possible after the injury as facial bones rapidly consolidate Either local surface anæsthesia is obtained by the insertion of gauze moistened with cocaine (5 per cent) or pentothal is administered The blades of a pair of sinus or Spencer Wells' forceps protected by rubber tubing are inserted into the nostrils Any existing lateral deviation of the septum is first corrected after which the nasal bones are

elevated and manipulated into their original position Much swelling may obscure the final position of the fragments, in which case an X ray should be taken so that adequate reduction can be confirmed No splint is necessary but a piece of firm strapping applied for two or three days provides the patient with confidence

Nasal polypi are of two varieties—fibrous and mucous Fibrous polypi are fibro-sarcomatous growths which arise in the roof of the nose and are usually discovered on routine examination following recurrent attacks of epistaxis Removal demands an extensive operation beyond the scope of minor surgery

Mucous polypi arise from one of the ethmoid bones and are regarded as excessive granulation tissue They denote underlying infection of the bone and mere *removal of polypi is followed by recurrence* sooner or later but the patient is relieved of his obstruction in the meantime Being hygroscopic they swell when the atmosphere is moist so obstructive symptoms in this country are more troublesome in the winter months On inspection through a speculum with the aid of reflected light, polypi present greyish, glistening swellings Removal of the polypi can be effected under surface anæsthesia The affected area is sprayed with a mixture of equal parts of cocaine (ten per cent) and liq adrenalin B P and the polypi are either removed with a snare or avulsed with suitable angled forceps

Radical treatment of the underlying ethmoiditis or sinusitis necessitates a major surgical operation

Hæmorrhage from the Nose—Before considering whether active measures are required or desirable for the treatment of epistaxis, consideration must be given as to the cause of the condition Thus patients suffering from hyperpiesis not uncommonly lose blood from the nose (or from piles) and as a result symptoms are relieved Unless bleeding is excessive this

physiological "blood letting" is beneficial to the patient, and he should be informed of the fact Children at puberty often suffer from transient epistaxis, which usually ceases spontaneously

If treatment is required any clothes which constrict the neck are removed, and the patient remains supine If bleeding is occurring from the anterior part of the septum it is usually controlled by pinching the nostrils with the finger and thumb Cold or iced water is applied to the root of the nose If bleeding persists a piece of gauze moistened with 1 1,000 adrenalin solution is inserted into each nostril and digital pressure is repeated If these methods fail, the surgeon should examine the nasal cavities by means of a speculum and reflected light and will sometimes see a bleeding point, which is often on the anterior and inferior part of the septum (Little's area) After cocainisation it should be touched with the galvano-cautery the hæmorrhage ceasing immediately If this form of cautery is unavailable a probe heated in a spirit lamp is a satisfactory substitute or pure carbolic acid is often very effective

If no obvious bleeding point is seen, the anterior nares should be packed with sterile ribbon gauze dipped in 1 in 1 000 adrenalin solution, the gauze being passed well into the nose If this is insufficient and blood is seen running down the back of the throat the packing should be removed and the posterior nares plugged This is conveniently performed in the following manner the loop of a double thread is passed through a rubber catheter, the end of which has been cut off The catheter is now passed through the anterior nares along the floor of the nasal fossa downwards behind the soft palate and the loop of thread made to project into the bucco-pharynx, where it is seized and pulled out of the mouth the catheter now being withdrawn from the nose A piece of

gauze about the size of a walnut is firmly attached to the loop and is pulled up behind the soft palate into the posterior nares as the thread at the anterior nares is pulled upon The nose is then packed from the front It is nearly always possible to stop epistaxis in this manner Dangerous epistaxis following fracture of the base of the skull has been successfully treated by ligation of the ethmoidal arteries which are exposed on the inner wall of the orbit

Tonsillectomy and Removal of Adenoids

Enlargement and infection of the lymphoid tissues of the naso-pharynx constitutes the most frequent morbid condition in this region The remarkable distribution of this tissue in what has been described as Waldeyer s ring reflects its protective function at the entry to the alimentary canal, and the greater frequency of its hypertrophy and infection in children is in accord with the incompletely developed natural resistance of the child

Waldeyer s ring is constituted by the two palatine, the pharyngeal, and lingual tonsils, with extensions in a variable direction and degree in the naso-pharynx, particularly toward the Eustachian openings Enlargement of the pharyngeal tonsil upon the back of the naso pharynx, often reaching to the roof is frequently marked and receives the general name ' adenoids ' Such hypertrophy may partially fill the naso pharynx, obstructing the posterior nares or the Eustachian orifices and may be associated with infections of part or of the whole respiratory tract Infection of the palatine tonsil varies widely in degree and results, and the organ may be large and spongy nearly meeting its fellow in the middle line as so often seen in the child or smaller and buried with a flattened surface and fibrous peritonsillar tissues as frequently seen in the adult

Tonsillectomy

The operation is carried out either by the use of the guillotine or by dissection The latter method is undoubtedly the better for it offers to the average surgeon a more precise mode and a better chance of complete removal In expert hands, and with correctly chosen cases often equally good results can be obtained however, by the guillotine

Tonsillectomy by Dissection.—In adults possessing the correct temperament, this is carried out conveniently under local anæsthesia, the patient being in the sitting position The anterior and posterior pillars and the upper pole are injected with procaine 2 per cent with adrenalin The surface is painted with 10 per cent cocaine solution

For others, and in children, general anæsthesia with gas, oxygen and ether is frequently used A Boyle Davis gag combining the uses of a tongue depressor and gag and carrying a tube for the delivery of anæsthetic, is of value it should be remembered that in the choice of a tongue piece for this it is better to err on the large size The patient is in the dorsal position, a small pillow under the shoulders, and the head well extended Anæsthesia should be of the third stage with disappearance of the swallowing reflex before the gag is introduced In placing the latter, the tongue must be central, and care must be exercised lest it be caught by the lower incisor teeth when the gag is opened Adequate lighting must be ensured by a spot light or by one on the operator s forehead The gag is held forward by the anæsthetist or may be fixed to a support strapped on the patient s chest

The tonsil is grasped with dissecting forceps of suitable length and a vertical incision is made through the anterior pillar 2 or 3 mm from its tonsillar margin (Fig 120) The correct plane is recognised by the pearly white colour of the capsule of the tonsil,

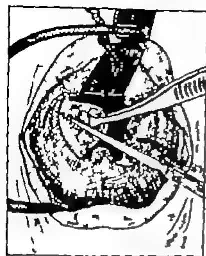





Fig 120.—Enucleation of tonsils by dissection.

and the incision is enlarged by blunt dissection upward on to the base of the tongue and downward to the soft palate The tonsil being grasped in holding forceps, it is drawn medially and the enucleation proceeds by gauze or forceps dissection which separates the organ from the muscle of the pharynx A snip with scissors frees the palatine extremity of the

anterior pillar from the tonsil and the latter is then peeled from the posterior pillar towards the tongue. The lingual attachment alone remains, and care must be taken that no part is here left behind when final separation is made. It is advisable to crush the final attachment with forceps before it is twisted off, for bleeding from this is not uncommon. A snare may be used for this purpose. A spurting vessel is sometimes seen, in which case it is grasped by a hæmostat and ligated with catgut. An adrenalin swab is then packed into the fossa and attention is turned to the opposite side. When the second tonsil is enucleated its fossa is similarly treated, and after a few moments both sides are seen to be dry. Troublesome hæmorrhage rarely persists if gentle and accurate dissection in the correct plane has been carried out. Should it occur, however, and other methods of control fail, the pillars should be sutured with two catgut sutures over a swab placed in the fossa. On the next day the sutures are cut and the swab removed.

Tonsillectomy by Guillotine.—This method is unsuitable for buried tonsils and for those with a flat surface which cannot be made to project from the pharyngeal wall. It is better suited to children with rounded and prominent structures, and in many of these a practised operator obtains a result equal to that from dissection. The speed with which it can be carried out and the small amount of anæsthetic required are its main advantages.

A closed Doyen's gag is inserted, the child is anæsthetised, preferably with ethyl chloride, to such a depth that the cough reflex is just present. He is then turned on to his right side, the gag is opened and the left forefinger is pressed against the anterior pillar of the fauces in a backward and outward direction, pushing the right tonsil inwards. Holding the guillotine (of Mackenzie's type) in the right hand, the ring is slipped over the projecting tonsil and, while main-

taining firm pressure with this in position the shaft of the instrument is brought upwards to the opposite corner of the mouth, so as to dislocate the tonsil from its bed The blade is then thrust sharply home and the tonsil removed The extirpation of the left tonsil is carried out with all movements reversed, and using opposite hands Hæmorrhage, which may for a few moments be brisk, rapidly stops with the application of iced water to the face, and removal of adenoids, when present, is then proceeded with

The assistance of the anæsthetist in steadying the head should be sought, and the table should be tilted slightly, feet upwards

Excision of Adenoids

The operation usually is performed after the tonsils have been removed The stage of anæsthesia should be such that the cough reflex is just present without that of deglutition being strongly established Aspiration of fragments of adenoid tissue and of blood is thus guarded against and the free operation of the curette is unimpeded by the contraction of the pharyngeal wall The patient is placed in the dorsal position the head being extended by placing a sand bag under the shoulders or by dropping the top flap of the table A Doyen's gag is introduced and opened a finger is passed into the naso pharynx and the exact distribution of the lymphoid tissue is ascertained

Undue prominence of the anterior tubercle of the atlas is noted and very occasionally an abnormality such as *meningocele is discovered* In the absence of such irregularities the operation is a straightforward one The tongue being depressed by a spatula held in the left hand a St Clair Thomson's caged curette is introduced in the mid line the curved part being directed towards the larynx, until the posterior pharyngeal wall is reached The instrument is then rotated through 180 degrees and the handle is raised

the cutting edge thus slipping behind the soft palate and coming in contact with the upper part of the nasal septum Using a firm and steady stroke the edge is drawn across the roof of the naso pharynx and down its posterior wall, finishing with a very slight jerk which detaches the adenoid mass The main mass being removed, outlying portions on the lateral pharyngeal walls or behind the Eustachian openings are removed by a few careful strokes of the curette The child must then be turned upon his side and the face and mouth sponged with iced water when hæmorrhage rapidly ceases

The operation is an easy one when carried out with precision and without haste, though time must not unnecessarily be lost The amount of force must not be great its degree is readily learned by experience

CHAPTER XII

FRACTURES AND DISLOCATIONS

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CLAVICLE

THE majority of fractures of the clavicle occur as a result of indirect violence, due to a fall on the shoulder or on the outstretched hand In children the fracture may be of the greenstick type

1 **The Junction of the Middle and Outer Thirds** is the commonest site

The outer part is displaced downwards by the weight of the limb The sternomastoid muscle holds up the inner fragment. The fragments may overlap

In adults the diagnosis is simple. Often it can be made by inspection alone—swelling and bruising may be seen, palpation makes it certain as the broken ends may be felt Crepitus can be obtained but attempts to elicit this are painful and may be dangerous In children the fracture may not be obvious, but within ten days a palpable swelling due to callus will be noticeable

2 **The Inner End.**—*Displacement is rare.*

3 **The Acromial End.**—A fracture at this site is uncommon, and is caused by direct violence

These conditions should not be mistaken for dislocations of the ends of the clavicle

4 **Between the Coraco-clavicular Ligaments.**—A *fracture in this position is also rare,* and displacement does not occur Localised tenderness and an X ray picture indicate the diagnosis

5 **Separation of the Epiphysis** may occur The centre appears at about the eighteenth year in the sternal end, and joins the shaft at twenty five years of age The sharp edge of the outer fragment distinguishes the condition from anterior dislocation of the sternoclavicular joint with its rounded appearance.

Treatment

There are two essentials (*a*) The weight of the upper extremity must be supported (*b*) The shoulders must be braced backwards and maintained in this position.

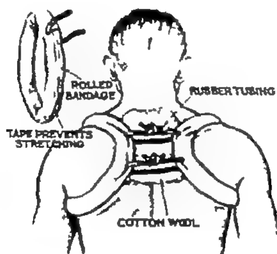


FIG 121.—Modified three-sling method.

Perfect splintage for this fracture does not exist. This is obvious when one considers the many methods of treatment described One method only will be discussed here

' *Three Slings* ' *with Collar and Cuff*.—Cotton wool is enclosed and sewn into a wide bandage to

form a quoit like ring Two such rings are used Two holes, 2 inches apart, are bored through each ring posteriorly Two pieces of rubber tubing are passed through the holes

The patient sits on a chair The rings are applied above the shoulder joint and over the outer end of the clavicle on either side The operator places his knee between the shoulder blades posteriorly and braces back the shoulders The rubber tubing is tied under tension over a wool pad (Fig. 121) A collar and cuff sling is applied underneath all clothing

The rubber tubing helps to maintain the tautness necessary to hold the fracture in position, while the collar and cuff tied close to the chin elevates the outer fragment It is essential that these patients should attend for examination twice weekly The slings become uncomfortable if not adjusted and severe chafing in the axilla and œdema of the arm may develop

Sayre's Method (Fig 122) may be useful in fractures in children

Three weeks' fixation is sufficient in ordinary cases. A month is advisable in severe fractures

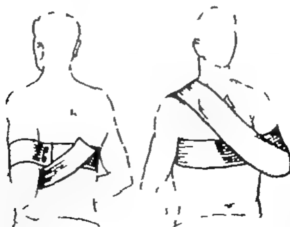


FIG 122.—Sayre's method, showing position of limb and application of strapping The skin surfaces of the chest and forearm should be separated by a layer of wool

Rehabilitation

Exercises on overhead pulleys, when the fixation has been removed, will overcome any stiffness in the shoulder joint (Fig 123)

Most patients are fit for work at the end of 4–6 weeks

Complications

These are rare and result usually from direct violence The axillary vessels may be injured producing a hæma toma, an aneurysm, or even gangrene

The brachial plexus especially the 5th and 6th cervical fibres may be in jured. Callus may involve the supraclavicular nerve

Excessive drooping of the arm in the case of gross mal-union may cause stretch ing of the lower trunk of the brachial plexus over the first rib

Non union is rare and if very troublesome is treated most effectively by excision of the outer fragment



FIG 123.—The overhead pulley This exercises the shoulder and elbow joints and discourages swelling.

HUMERUS

1 Anatomical and Surgical Neck Fractures.—Fractures of the *anatomical* neck are usually the result of direct violence They occur in the elderly and are uncommon

Fractures of the *surgical neck* region (Fig 124) are usually the result of indirect violence. They may occur at any age, and are common

The region of the shoulder joint is swollen and tender All movements active or passive are resisted on account of pain Shortening up to an inch may be present. Crepitus is rare owing to impaction



Fig 124 —Fracture of the surgical neck of the humerus.

The fracture is generally impacted If there is angulation the angle points forwards in the lateral plane The lower fragment may be adducted or abducted If the fragments are not impacted, a weight hanging plaster (Fig 125) will maintain the position, provided the patient is ambulatory

Splintage for this fracture is an unnecessary encumbrance The patient is given a sling for a week Radiant heat eases the pain

Rehabilitation

Active exercises are encouraged from the beginning If the force of gravity be eliminated by forward bending and a sling (Fig 125) pain on movement is reduced and the patient s co-operation achieved Overhead pulleys (Fig 128) may later be used and continued until a full range of movement has been obtained Rotation movements are carried out most effectively by encouraging the patient to place the hand behind the neck and the back

These patients can resume heavy work at the end of three months

Complications

Fracture Dislocation —This is diagnosed from simple dislocation by the fact that the tuberosities do not rotate with the shaft.

Treatment —(*a*) Strong steady traction with the arm almost vertical in a relaxed patient may reduce the dislocation and fracture

(*b*) If this method is unsuccessful open reduction is necessary The shoulder is approached through an anterior incision, and the head is either levered back into the glenoid cavity or excised Kocher's method of reduction (p 855) should never be attempted if there is a question of fracture-dislocation



FIG 125 —Exercising the shoulder without straining a fracture of the humerus. The patient bends forwards and downwards. The elbow is held at a right angle and suspended from the neck by a padded bandage. Plaster is used for fractures of the shaft of the humerus where weight traction is necessary In this position all shoulder movements below a right angle can be performed painlessly

The axillary nerve may be damaged either at the time of the injury or by the subsequent manipulations causing paralysis of the deltoid muscle This should be treated by placing the arm on an abduction splint

Separation of the Epiphysis—This is usually a result of indirect violence, and resembles a surgical neck fracture. The epiphyseal line between the head

and shaft of the humerus is often mistaken fc injury in X ray photographs

The displacement is reduced by traction and a tion of the extended arm This is best perf with the patient lying on the floor The ope sitting on a low stool in line with the pa grasps the wrist firmly, places his stockinged fc the superior aspect of the shoulder joint, and forcible traction Sometimes there is marked a tion backwards This is reduced by placin clenched fist behind the shoulder joint as a ful and levering the abducted arm backwards

2 **Greater Tuberosity** —These fractures are d *indirect violence, over 80 per cent. occurring* complication of subglenoid dislocation

An X ray picture is essential to clinch this diag Even then, care must be taken in the reading film to differentiate between a displaced greater t osity and calcification in the supraspinatus tend

In injuries to this region Codman s syndrome is p *There is a tender spot at the site of the injury to the g* tuberosity The pain is referred to the insertion of m way down the deltoid muscle. The arm can be abc actively only through 40 degrees from the side. P *movement is possible almost to the vertical position, b* patient winces as the arm passes from 90 degrees t degrees, that is, as the tender spot rubs on the acromio

The treatment is the same as in surgical fractures—that is, assisted active movements fron beginning—provided the fragments are not sepa widely If painful, the treatment may be su mented by a course of radiant heat to the shou joint. If the pain is so severe in the early stages active movements are interfered with, 5 to 10 c. 2 per cent. novocaine are injected into the te region, *and full movements performed* immedi afterwards In intractable cases of Codman s syndr the outer part of the acromion is excised

These patients can resume their full work at the end of two months

The only notable complication of this injury is the stiffness that results if the joint is immobilised as part of the treatment. If this occurs, the shoulder is manipulated under a general anæsthetic unless pain is marked "Never manipulate a shoulder until the patient can sleep on it"

3 **Shaft.**—These fractures occur as the result of direct or indirect violence.

The history, pain and tenderness at the fracture site, the appearance, and the abnormal mobility make the diagnosis obvious An X ray indicates the position of the fragments

A detailed description of the position taken up by the fragments as a result of muscular actions is unnecessary nowadays, when X rays should always be available before a fracture is treated

A plaster is applied from the axilla down to and including the elbow joint (Figs 126 and 127) A sling is provided

Reduction is seldom necessary as the weight of the plaster and limb brings the fragments into line in almost every case The forearm may be included if extra weight to reduce the fracture is desired or weights may be included or attached to the plaster



FIG 126.—A 3-inch U-shaped slab extends from the axilla round the elbow to the acromion. It is fixed by one gauze and two plaster bandages.

During the time the fracture is immobilised, it is absolutely essential to prevent joint stiffness The fingers

and wrist are free, and active movements of these joints are vigorously encouraged The shoulder joint is exercised with the patient stooping forwards (Fig 125) This is painless and does not interfere with the alignment.

If the fracture is uncomplicated the patient can return to *heavy* work at the end of four months

Complications

(1) *Radial Nerve Injury* —Weakness of dorsi flexion of the wrist may occur immediately from contusion or

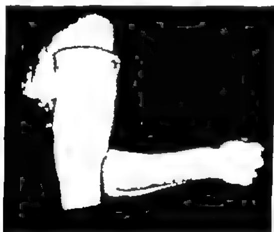


FIG 127 —Plaster completed.

division or as a sequel by involvement of the nerve in callus The immediate treatment is the application of a cock up splint Later exploration may be necessary

(2) *Non-union* —This occurs more frequently here than in any other long bone, except the tibia. It is commonest when the fracture is through the middle third This condition is treated by chip grafts from the ilium and an onlay from the tibia graft followed by efficient splintage

4 **Lower End.**—Several types of fractures occur at the lower end of the humerus From the point of

view of treatment and prognosis, it is essential to differentiate between them

Supracondylar

The fracture is just above the line of the condyles

(*a*) *Children* —The deformity depends upon the mechanism of the injury A fall on the outstretched hand with an extended elbow causes the common backward displacement, or an *extension* fracture A fall on the point of the elbow causes anterior displacement, or a *flexion* fracture.

(*b*) *Adults* —Falls on the point of the elbow causing *flexion* fractures are more common

Transcondylar

This is a fracture through the condyles in adults In children it becomes an epiphysed separation The epiphysis, with a flake of bone from the metaphysis, is displaced backwards

The lower fragment is displaced backwards and inwards, and rotated medially that is, pronated

It is impossible to differentiate clinically between these two types of fractures in children They can, however, be distinguished from dislocations of the elbow by the fact that the three classical bony points —the two epicondyles and the point of the olecranon —have not changed their relative positions The swelling tenderness, and pain often prevent adequate examination Hence X ray examination in all elbow injuries is essential.

Treatment

For both types a general anæsthetic is necessary

Supracondylar —Any gross displacement is corrected The elbow joint is flexed forcibly This corrects the backward displacement. Then the flexion is decreased slightly and with finger and thumb on the epicondyles the lower fragment is manipulated medi

the flexion is reduced and the plaster is completed with the elbow at a right angle The patient wears a sling to take the weight of the plaster

The plaster is kept on for two months, but an interim X ray is taken at the end of a fortnight to confirm the position

5 **T- and Y-shaped Fractures.**—These are really supracondylar fractures with a vertical line running through the lower fragment into the joint They result usually from direct violence are rare, and occur generally in adults

Manipulation under the X ray control with powerful side-to-side compression is attempted. If unsuccessful, open operation may be necessary

6 **Medial Condyle.**—This fracture occurs usually as a result of direct violence. The line of fracture passes through the trochlea, and displacement, when it occurs, is downwards and backwards The ulnar nerve may be injured.



Fig. 128 —Medial epicondyle included in joint

The fragment can usually be manipulated back into position, and plaster is applied as in supracondylar fractures If there is no displacement, active use is encouraged

7 **Lateral Condyle** —This usually follows direct violence. It may be due to indirect violence when the head of the radius is driven against the humerus When there is no displacement, immobilisation is unnecessary and active exercises are recommended When displacement is

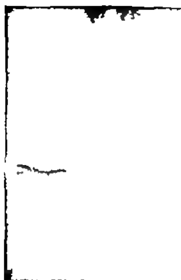


Fig. 129.—Medial epicondyle reduced.

present, manipulation is attempted and, if unsuccessful, open reduction may be necessary

8. **Medial Epicondyle.**—This separation follows indirect violence from forcible abduction of the elbow joint. The flexor muscles are stretched and the epicondyle is avulsed from the humerus, and frequently pulled into the joint (Fig. 128). The ulnar nerve is commonly involved.

Immobilisation in a sling is sufficient for slight displacement. If the *fragment is in the joint, it must be replaced* by manipulation or operation.

Method.—Under general anæsthesia the extended elbow is abducted (Fig. 130). This opens the inner



Fig. 130.—Manœuvre to reduce displaced medial epicondyle. The elbow is extended fully and the forearm supinated. The elbow joint is then forcibly abducted.

side of the joint and stretches the flexor muscles to which the epicondyle is attached. As a rule the

epicondyle "jumps" back into position (Fig 129)

Powerful faradism to the flexor group of muscles is sometimes successful

If these treatments fail, the fragment is either excised or stitched in position

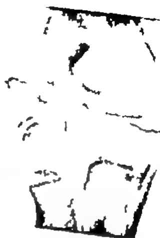


Fig 131.—The capitellum, with a flake of the diaphysis, is displaced and rotated laterally

9 **Lateral Epicondyle.**—These fractures are rare, and seldom need any special treatment apart from immobilisation

10 **Capitellum.** — The capitellum may be displaced completely, and rotated by as much as 90 degrees (Fig 131)

Treatment

The patient is anæsthetised The extended elbow is adducted Then the joint is grasped so that the fingers interlock on the inner aspect, and the two thumbs press upwards and inwards forcibly, so as to reduce the lateral rotation and displacement (Fig 132) The elbow is then immobilised for six weeks in plaster at a right angle, with careful moulding over the fragment (Fig 132) If the fracture is not reduced a grotesque



Fig. 132.—Note the indentation in the plaster over the capitellum



Fig 133 —Old unreduced capitellum fracture.

appearance develops in later life (Fig 133)

Rehabilitation of Elbow joint Lesions

Patients should be encouraged to use the limb by taking part in games or pastimes, such as bowls, darts, carpentry and by the use of overhead pulleys (Fig 123) Massage, and passive or forced movements in the early stages, are contraindicated, as they lead to new bone formation, which may limit permanently the movements of the joint. When there is no further fear of excessive bone formation, radiant heat and massage are helpful

Patients can usually resume their full work at the end of two months

Complications

(1) Dislocation of the elbow
(2) Nerve injuries, especially the ulnar nerve
(3) Volkmann's ischæmic contracture
(4) Myositis ossificans traumatica
(5) Ossification in the ligaments.

Ulna

1 **Olecranon** —If the violence is direct, there is little separation of the fragments If indirect, there is wide separation from the action of the triceps (Fig 134)

Diagnosis

Wide separation is obvious In fractures resulting from direct violence, *a small gap usually develops*

This added to the swelling tenderness and pain on movement makes the diagnosis simple

Treatment

The gap (Fig 134) is closed by extension and manipulation (Fig 135) and a well moulded skin tight plaster applied with the elbow in full extension A piece of thin adhesive felt is placed over the olecranon



FIG 134.—Wide separation of the fragments following indirect violence.



FIG 135—Same case treated in extension for eight weeks. There is firm union, and the patient, aged 77 obtained full movement.

area, and a plaster slab is fixed along the dorsal aspects of the arm forearm and hand by a gauze bandage 6 yards long The cast is completed by two plaster bandages During the application of the plaster and while it is setting the extension must be maintained and the fragments held together by firm pressure The position is maintained for eight weeks Then active movements help to restore flexion Residual limitation of movement, which strange to say is very rare even in elderly people responds to manipulation

Active overhead exercises are essential to prevent circulatory trouble while in plaster (Figs 128 and 136)



FIG 136—Another over head exercise to prevent swelling and stiffness of shoulder

When there is no displacement, the fracture is treated in a sling for ten days Operative fixation is seldom necessary Excision has a certain vogue it *should* never be performed if half or more of the olecranon is involved as this would allow the elbow to dislocate forwards

2 **Coronoid Process.**—This is a complication of backward dislocation of the elbow joint If the fracture is at the base of the coronoid process the diagnosis is suggested by the fact that the dislocation readily recurs If the tip only is fractured an X ray is necessary to discover the injury

Treatment

The limb is incorporated in plaster In fractures of the tip the elbow is fixed in plaster at a right angle If at the base the elbow is flexed until the fragments are approximated as shown by an X ray

3 **Shaft.**—In isolated fractures of the ulna, the violence is direct.

Diagnosis

If the radius is intact, there is slight flexion of the upper fragment by the pull of the brachialis The lower fragment is drawn towards the radius by the pronator quadratus The posterior border of the ulna is subcutaneous and any fracture is palpable.

Treatment

The limb should be immobilised in plaster for six weeks The method of fixation is discussed under fractures of both bones of the forearm

In fractures of the upper third of the shaft where there is an anterior dislocation of the head of the radius (Monteggia) open operation may be necessary to reduce both satisfactorily

4 **Styloid Process.**—Very rarely this is fractured without the radius being involved It is diagnosed by a tender spot over the fracture, and pain at extremes of movements If pain is severe it is treated in a plaster as for Colles' fracture If the injury is old an injection of a few c c of novocaine is indicated

Radius

The Head.—There are three types of displacement

I The head may be impacted into the neck, so that the outer aspect is on a lower level than the inner but the upper table is unbroken

II A vertical fracture through the middle or outer third of the head with or without downward and outward displacement of the outer fragment.

III Fragmentation of the head

Diagnosis

Pain, swelling and tenderness over the head of the radius, with limitation of movement, especially extension and pain on pronation and supination are usually pathognomonic The diagnosis should always be confirmed by X rays It is essential that the antero-posterior X ray should be taken in full supination, and with as much extension as possible, so that a clear joint space is visible between the humerus and radius otherwise the fracture may be obscured

Treatment

Type I—This is treated by encouraging active movements from the beginning At the end of a week, the patient is usually able to return to work. It is impossible to reduce this fracture by ordinary manipulation.



FIG 137—Type II showing downward displacement of outer segment of the head of the radius.

Type II (Fig 137)—The patient is given a general anæsthetic. The counter traction band is fixed over the arm An assistant exerts traction by pulling on the fingers, *with forearm fully supinated* The medial aspect of the elbow rests on a pad on a table. A piece of adhesive felt is fixed over the region of the fracture, and, using a blunt instrument, *very forcible pressure* is exerted on the broken fragment in an upward and inward direction. It may even be necessary to use a broad punch and hammer to replace the fragment (Fig 139) The skin is not damaged by these manipulations, provided the felt is fixed accurately beforehand *Most cases can be reduced by this method* provided the fracture is of recent occurrence (Fig 138 shows the position after reduction)



FIG 138.—Fragment replaced.

If manipulation fails or if the fracture has existed for some weeks the fragment can be elevated with a

Steinmann's nail or spike through a small incision over the head of the radius If this is successful, the punch should again be applied in an attempt to impact the fragments

Active movements are begun the next day

Type III —Manipulation may be attempted, but usually the head will require excision by open operation.

In types I and II the patients can return to work within a week In type III it depends upon the



Fig 130—The author's method Traction is exerted on the supinated forearm Counter traction by hand over the upper arm. The elbow rests on a pad of wool on a table. A piece of adhesive felt prevents skin damage from the punch.

severity of the injury Limitation of movement is common Osteo-arthritis progressing to ankylosis may occur in untreated cases.

Fracture of the neck of the radius can be elevated in the same way

The Tuberosity —In this uncommon fracture the fragment is drawn upwards and forwards by the biceps and can be felt on the anterior aspect of the joint, especially when an active attempt is made to flex the elbow

The arm is immobilised in the fully flexed and supinated position by strapping, the object being to relax the biceps and preserve supination

The Shaft

(a) *Upper One third* —Above the insertion of the pronator teres the upper fragment is supinated by the biceps and supinator, and flexed by the biceps The lower fragment is pronated and approximated to the ulna, thus usually causing an angle pointing inwards

(b) *Middle and Lower One thirds* —Below the insertion of the pronator teres, the upper fragment is in the mid position The lower fragment is pronated and both are approximated towards the shaft of the ulna The treatment is discussed under Radius and Ulna

Radius and Ulna

1 **Upper and Middle Thirds** —With direct violence, the break usually occurs at the same level in both bones In indirect violence, the ulna is frequently broken at a higher level than the radius The fractures are commonly greenstick in children

The displacement varies greatly according to the obliquity of the fracture, and the character and direction of the violence The fragments are often approximated Overlapping is common

The diagnosis is easy on account of the abnormal mobility the pain tenderness and crepitus at the fracture site

Treatment

In fractures of the upper third of the radius the forearm is put up in *supination* In all others it is put up in mid position The elbow joint is at a right angle and is included in the plaster

Method —The patient is anæsthetised on a flat table A counter traction band is placed over the arm close to the elbow joint. Manual traction is exerted

by an assistant pulling on the index, middle, and ring fingers with one hand, and the thumb with the other (Fig 140) Slipping can be prevented by painting



Fig 140 —Interosseous pressure is exerted to separate fragments.

the fingers with mastisol and covering them with gauze, or by bandaging with elastoplast. Mastisol is easily removed with spirit. The operator's fingers and



Fig. 141 —The rods being applied over interosseous space to maintain separation of fragments.

thumbs then exert powerful pressure on the interosseous space, so as to separate the fragments (Fig 140) Separation is maintained by the application

over the plaster slabs of two wooden rods, each twice the thickness of an ordinary lead pencil and 4 inches long (Fig 141) The rods are pressed in forcibly on the slabs between the broken ends (Fig 142)

A slab is made from a 6-inch plaster bandage 5 yards long. This is long enough to reach from the upper third of the arm behind the elbow to the knuckles It is applied directly to the skin and well



FIG 142.—Forcible pressure is maintained over the rods until the plaster has set.

moulded to the contour of the limb The edges at the elbow are nicked and folded over evenly One wooden rod is placed along the back of the slab between the bones at the fracture level. Then a *gauze bandage 6 yards by 6 inches, is rolled on to* fix the slab and stick. This bandage is not applied tightly but it must never be omitted as it leaves an area on the limb which is uncovered by plaster to allow for swelling

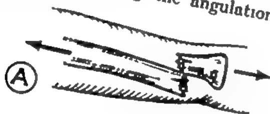
A *short slab 4 inches wide, is applied* to the volar aspect of the forearm from elbow to wrist, and another rod is placed along it and fixed by a circular plaster bandage. While traction is maintained, forcible pres sure is exerted on the two rods to separate the broken

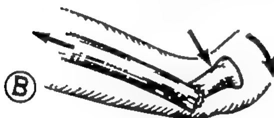
ends Two more circular bandages are now applied over the arm, forearm and wrist (Fig 142)

In fractures of one bone with overlap simple traction, however powerful may not be sufficient. An attempt is made to hitch the end of one fragment on to the other This is done by forcibly angulating the fragments until the edge of one can hinge on that of the other and then straightening the angulation (Fig 144)



Fig 143.—A counter traction band with spreader is in position over the upper arm. Manual traction is exerted on the fingers. The plaster extends from knuckles to deltoid.





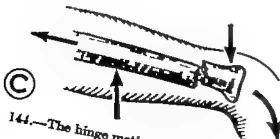


Fig 144.—The hinge method for reducing overlap.

2 **Fractures of the Lower Third of the Forearm.**—The deformity is usually due to a backward displacement of the lower fragments with angulation pointing forwards Occasionally the fracture is complete, with marked angulation and overlapping

The history, tenderness and obvious deformity make the diagnosis simple

In the greenstick type, the deformity can be corrected by manual manipulation Even in small children powerful pressure is necessary The operator should aim at over-correction which seldom does more than correct the deformity It is a mistake to be gentle through fear of making the fracture complete If it is complete, traction and manipulation, *as for both bones at a higher level,* are used, or the hinge method described above may be necessary In greenstick fractures it is usually safe to leave the elbow free unless the distal radio-ulna joint is dislocated, when the elbow must be included and the forearm supinated

Method—A slab is applied from elbow to knuckles, and fixed with a gauze bandage 6 yards by 6 inches and one circular plaster bandage. The index finger and thumb are separated by a pad of wool In adults the elbow must be included as in fracture at a higher level

Colles' Fracture

This is a fracture of the lower end of the radius, the ulnar styloid being broken commonly (Fig 145) *It occurs usually as a result of a fall on the out stretched hand*

There are four elements in the deformity

1 Impaction
2 Backward displacement and rotation
3 Radial deviation
4 Supination

Comminution is common



Fig 145 — X-ray of a typical Colles fracture. Note the dislocation of the distal radio-ulnar joint

Dislocation or subluxation of the distal radio-ulnar joint is present to some degree in every case. The ulnar styloid is displaced laterally

Diagnosis

The history and the "dinner fork deformity" are classical On palpation the radial styloid is at the same level or even higher than that of the ulna all movements are limited and painful swelling and tenderness may be severe An X ray confirms the diagnosis In cases a week or more old discoloration due to the hæmatoma is evident on the inner side of the elbow joint

Treatment

The patient is anæsthetised with nitrous oxide Local anæsthesia is indicated when a prolonged manipulation is necessary or when general anæsthesia is contraindicated A counter traction band is placed over the arm above the elbow the other end being fixed to a hook in the wall. If a band is not available, a wide strong bandage can be used A loop is made on one end for the arm, and the other tied to a door handle

Traction



Flexion



Pronation



Ulnar deviation



FIG 146

Reduction.—Four movements are carried out to reduce the four elements in the deformity (Fig 146)

(1) Powerful longitudinal traction.
(2) Forcible volar flexion
(3) Ulnar deviation
(4) Pronation

Fixation

The thumb and lateral three fingers are then taken by an assistant, the thumb in one hand and fingers in the other, in a position of ulnar deviation, and strong traction is maintained as in fractures of the forearm A more powerful pull is kept up on the thumb and it is so held that it makes a straight line with the radial border of the forearm and forces the wrist into ulnar deviation The forearm is measured from the knuckles to the elbow, and a 6-inch plaster slab made to this measurement It is applied to the dorsum of the forearm and wrist, being accurately moulded so that the narrowest part of the cast is at the wrist A small piece of wool is now placed between index finger and thumb and the slab wrapped on by a gauze bandage The plaster is allowed to set care being taken that the hand is in mid position, *not volar flexed*, and in *full* ulnar deviation (Fig 147)



Fig 147.—The dorsal slab extends from the knuckles to below the elbow It is moulded accurately round the wrist. The hand is in full ulnar deviation.

The patient is warned about obstruction to the circulation and is examined next morning If the fingers are very swollen, the gauze bandage is reapplied,



Fig 148—The gauze bandage is replaced weekly and the wrist area strapped.

and the patient recommended to elevate the limb at home. If the circulation remains satisfactory, the bandage is changed in three days time.

Rebandaging

If a circular plaster bandage is applied over the gauze which holds the slab in place, the fracture will slip, because when the swelling subsides, the slab is no longer in firm contact with the limb This difficulty is *obviated by re applying the gauze bandage very firmly twice a week.* If circular strips of strapping are applied firmly over the bandage at the wrist, *once* weekly is sufficient (Fig 148)

In patients under 60 years, plaster is maintained for four weeks In older patients it is maintained for six weeks

Rehabilitation

It is impressed on the patient from the beginning that the following movements are essential

The Shoulder Joint—The patient is encouraged to place the hand behind the head and behind the back, i e full external and full internal rotation.

The Elbow Joint—Extension and flexion are usually easily obtained They are very important to prevent the stiffness occurring from the spreading hæmatoma on the inner aspect of the joint. Pronation and supination are more difficult, as the pronator quadratus and the distal radio-ulnar joint have been injured by the fracture. This movement must be

performed with the elbow close to the side It can be encouraged by turning a door knob or a special instrument

Fingers — All the finger joints must be flexed and extended *fully* The thumb is opposed so as to meet the little finger

The patient is encouraged to use the hand as normally as possible Preferably he should do his usual work, or imitate it by similar or less strenuous exercises, such as typewriting

These patients can usually return to work in seven weeks

Complications are rare, they are

1 *Recurrence of the Displacement due to Faulty Splintage* — This is prevented by rebandaging the cast

2 *Persistent Pain over the Fractured Ulnar Styloid* — A manipulation provided the fracture is three months old may give relief If this fails a few c.cs of novocaine are injected into the tender spot, and the patient encouraged to use the wrist while the anaesthetic is still acting Finally, excision may be necessary

3 *Rupture of the Extensor Pollicis Longus Tendon* occurs in 2 per cent. of cases from fraying over the proximal end of the lower fragment It may be noticed as soon as the second week by the patient's inability to extend the terminal joint of the thumb A simple means of restoring function is by a 'gap' suture (Trevor) In this method the tendon ends are not approximated but are connected by a couple of strands of stout nylon The patient can use the thumb safely in a fortnight Suture of the distal end of the tendon to the abductor longus pollicis tendon, or transplanting one of the extensor tendons of the toes as a graft are also used

4 *Sudeck's Osteoporosis* (Fig 149) is a condition in which rarefaction of bones of the wrist and hand is out of all proportion to the injury There is persistent pain may be for months, narrowing of the joint spaces of the wrist, and sweating of the hand The condition is said to be due to involvement of the dorsal interosseous nerve. It is best treated by immobilisation in plaster with active use of the fingers Peri arterial sympathectomy of the brachial artery has been used The condition may take a year to disappear



FIG 149—Sudeck's osteoporosis, showing marked rarefaction of carpus

Separation of the Lower Radial Epiphysis

The lower fragment is displaced and rotated backwards Usually a flake off the dorsal aspect of the diaphysis remains attached to the epiphysis

There is a slight "dinner fork" deformity Swelling is marked, crepitus is absent. Pain and tenderness are present at the site of the displacement An X ray confirms the diagnosis

Treatment—As for a Colles fracture Swelling may be troublesome, and these children should always be examined on the following day

The Carpus

Scaphoid.—Fracture is due to indirect violence

Displacement.—In many cases the fracture consists of a crack running through from the carpal to the radial articular surface, without displacement. The displacement that occurs in complete fracture consists of a gap between the fragments When however,

there is a fracture of the scaphoid accompanied by an anterior dislocation of the semilunar the proximal scaphoid fragment is displaced forward When the dislocation has been reduced this should be remembered and the fracture reduced at the same time To do this the thumb which has pushed forward the os magnum (Fig 202) should be transferred a little laterally to push the distal scaphoid fragment forward very forcibly

Even nowadays with modern X ray facilities this fracture is not always recognised at first Every crack in the scaphoid, especially if it traverses the width of the bone, should be treated with respect. A crack, if untreated will end as a well marked gap Patients have been known to complain for years of slight pain on full radial deviation of the wrist, without a fracture being recognised Tenderness in the anatomical snuff box and on the dorsal aspect of the wrist over the scaphoid together with pain on forced abduction or adduction of the wrist suggest a fracture of the scaphoid De Quervain s stenosing tendovaginitis is often mistaken for a scaphoid fracture In this however the pain and tenderness are always on the lateral side of the radial styloid and not over the anatomical snuff box. X rays are essential to corroborate the diagnosis An oblique as well as the usual views is taken Doubtful cases are X rayed again at the end of a fortnight

Treatment —The wrist after reduction is immobilised by a plaster cast as in the case of a Colles fracture and the thumb metacarpal is included It is reinforced by one or two circular plaster bandages and fixed in a position of slight dorsi flexion and *ulnar* deviation

In recent fractures with no separation, the plaster is removed at the end of two months Where separation exists, it is retained for three months and further treatment governed by the X ray appearances



Fig 150 —Note the tapering of the radial styloid indicating osteo-arthritis.

Old fractures, even after years will sometimes join if immobilised for long enough but there is a risk of wrist stiffness

Complications

Non union —This can be treated by prolonged immobilisation as above or by grafting Excision of one or both fragments or of the whole proximal root gives a weakened wrist Osteo-arthritis is liable to occur in neglected cases (Fig 150)

Patients with recent fractures treated efficiently are able to return to their work within three months

Fractures of the Other Carpal Bones are uncommon and are treated on the lines laid down for scaphoid fractures

METACARPALS

The displacement consists of angulation pointing backwards and shortening when the fracture is complete Often the displacement is negligible.

The history, the shortening of the knuckle, the pro-



Fig 151 —Before reduction.



Fig 151a —After reduction.

trusion and swelling over the posterior aspect of the bone, and the localised tenderness suggest the diagnosis An X ray is confirmatory (Figs 151 and 151A)

Treatment

If there is displacement, the patient is positioned as in Fig 152 Then strong manual traction is exerted on the finger corresponding to the broken metacarpal In the common greenstick fracture at the neck



FIG 152.—Method of reducing fracture of neck of metacarpal. A counter-traction band is placed over the arm. Traction and hyperextension are exerted on the affected digit.

of the 5th metacarpal, powerful pressure must be exerted on the posterior aspect of the fracture with the thumbs, while traction and hyperextension are carried out on the finger (Fig 152) Although this hyperextension is forced, it never damages the ligaments When the shaft is broken a long plaster as for a Colles' fracture and including the involved metacarpo-phalangeal joint is used. If the fracture is in the neck of the bone, a short plaster (Fig 153) is sufficient

A plaster slab long enough to extend from the proximal interphalangeal joint to below the wrist, is applied to the dorsal aspect of the hand (Fig 153) The slab is cut away from the *unaffected* fingers at


FIG 153.—A short plaster is used for fractures of the necks of metacarpals. It allows for wrist and finger movements.

the level of the knuckles. This leaves the slab continuous on the dorsal aspect of the first phalanx of the affected digit. Traction is maintained on the finger while the plaster slab is fixed by a gauze bandage, which also fixes the extension of the slab on to the finger Then, with the thumbs, the plaster is moulded forcibly on the posterior aspect of the broken bone to maintain the reduction of the angulation The plaster is completed by one circular bandage *The metacarpo-phalangeal joint is fixed in a position of semiflexion and the digit should be so rotated that when flexed it will point to the scaphoid tubercle*

If the joint is immobilised in a position of extension severe residual stiffness is the result Elaborate measures, such as pin traction through the fingers, are unnecessary, unless marked shortening recurs after reduction of oblique fractures, and in the case of Bennett s fracture

BENNETT'S FRACTURE

This is a fracture of the volar pyramidal shaped process of the base of the first metacarpal together with a dorso-lateral dislocation of the metacarpal on the lesser *multangular bone (Fig 154)*

Treatment

A hole is bored through the base of the distal phalanx of the digit ¼ inch superior to the cuticle

from side to side The finest drill available is used A piece of very fine wire is then passed through the phalanx, the skin wire junctions are sealed with mastisol The joint is positioned as in metacarpal fractures (Fig 155) and the thumb forcibly abducted and extended This reduces the fracture (Fig 156) A plaster slab is applied as in a Colles' fracture but it is cut away over the lateral side of the hand and wrist leaving the fracture site free A *well padded* Böhler's wire finger splint is fixed along the radial side of the wrist and back of the thumb with a plaster bandage It protrudes for 1 inch



FIG 154.—Bennett's fracture-dislocation.



FIG 155.—A counter-traction band fixes the upper arm. Showing how traction in abduction, using thumbs as a fulcrum reduces the fracture-dislocation.



FIG 156.—After reduction

beyond the tip of the thumb The wire is attached to the end of the splint (Fig 157) Thumb and splint are together forcibly hyperextended and strong



Fig 157—The plaster fixes the finger splint along the lateral aspect of the thumb. This is attached to the wire which passes through the pulp or preferably through the actual phalanx of the thumb

pressure is exerted on the dorso lateral aspect of the base of the first metacarpal to reduce the fracture dislocation

By this method of fixation all the unaffected fingers are free, and full range of movement, as in Colles fractures is possible from the beginning



Fig 158—Typical angulation in fracture of shaft of phalanx.

Phalanges

Fractures of these bones may be confined to the shafts or may involve the joints

The violence is either indirect or direct. In the terminal phalanx, fractures of the shaft are due to crushing injuries

Fractures of the shaft, due to

indirect violence, show a typical deformity with the angle pointing forwards (Fig 158) Fractures due to crushing violence display a "burst" appearance In fractures involving the joint, a condyle may be displaced The extensor tendon is sometimes torn off the terminal phalanx, frequently carrying with it a flake of bone and causing mallet finger

The history and the appearance of the finger are usually diagnostic but the diagnosis should be confirmed by an X ray

Treatment

Type 1—Where the shaft of the proximal or middle phalanx is involved

The patient is anæsthetised and a counter traction band placed in position as for a Colles fracture A plaster slab is then applied so as to cover the affected digit and the back of the hand as far as the wrist The prolongation of the slab should extend as far as the distal interphalangeal joint in fractures of the proximal phalanx to allow movement of the terminal joint When the middle phalanx is involved the distal joint must be included The slab is fixed with a gauze bandage Then powerful traction and flexion are exerted on the affected finger, to correct the shortening and angulation This position is maintained until the slab is set. The plaster is completed by another circular bandage

This method has the advantage of leaving free the wrist the unaffected fingers and in many cases the terminal joint of the injured finger (see Metacarpals) It obviates the tiresome stiffness which so commonly follows fractures of the phalanges when treated in the extended position. Wire traction is rarely needed.

Type 2—Where a condyle is displaced.

The fracture is manipulated under X ray control. Strong lateral or medial pressure is used and the finger put up in plaster In an old case the fracture

is broken down first If reduction is not maintained pin traction is used (see p 310)

A dorsal plaster slab 8 inches wide is applied from elbow to knuckles and wrapped on with a gauze bandage A 4 inch volar plaster slab is applied from the wrist to the elbow A *padded* Böhler's finger splint (Fig 159) is fixed along the front of this slab and volar aspect of the finger It projects 1 inch beyond the tip of the finger and is maintained in position by a circular plaster bandage Both finger and splint are semi flexed The traction wire is fixed to the notch at the end of the splint. Then by increasing the flexion traction can be exerted on the displaced fragment, and the fracture reduced (Fig 159) Radial or ulnar deviation may be necessary

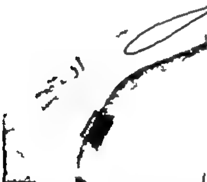


Fig 159 —The wire has been pushed through the pulp and fixed to the end of the splint. Finger and splint have then been flexed thus exerting traction and reducing angulation.

Type 3 —Where the insertion of the extensor tendon has been avulsed causing a mallet finger A plaster is applied as for metacarpals (Fig 158) and phalanges, and extended to include the extremity of the finger The tip is then firmly pressed against the patient's thumb tip The proximal interphalangeal joint is therefore kept at a right angle while the distal joint is hyperextended This position is maintained until the plaster has set (Fig 160) The plaster is removed at the end of six weeks.

Type 4 —Where the terminal phalanx is crushed These injuries are often compound The wound is excised and sutured where possible, and splinted in slight flexion Closed fractures are treated by immo-

bilisation in semi flexion using narrow strips of strapping (see Fractures of Toes)

Severe finger fractures should be immobilised for one month

Throughout the period of fixation and until full movement is regained the patient is encouraged to exercise the remainder of the upper limb Special attention is paid to finger pulleys and if possible exercises simulating the patient s work.

Patients should be able to return to their full work within six weeks



Fig 100—The distal interphalangeal joint is hyper extended The proximal joint is flexed to a right angle Both are held in position by plaster This is an alternate method of applying the plaster It is preferable however to incorporate the hand This prevents the plaster from slipping

Complications

1 Stiffness of the interphalangeal joints is best treated by the push and pull' method.

Push and Pull Method—A dorsal cast is applied from knuckles to elbow and fixed by a gauze bandage Then one end of a stout 4 inch linen bandage, 2 yards long is placed along the dorsal aspect of the cast, and fixed by a circular plaster bandage The linen bandage is brought over the dorsal aspect of the fingers along the inner side of the forearm and elbow round the back, over the front of the chest and the same shoulder and finally pinned to itself The patient compresses the back of the fingers against the linen bandage by pushing thus increasing flexion This method is gradual and does not produce the deleterious reaction so common after vigorous manipulations for stiffness

2 In compound fractures, the tendons may be severed If the wound is clean excision and tendon suture is performed Lacerated wounds are merely excised and the repair of the tendon postponed until the risk of sepsis has diminished

SPINE

The common sites are the bodies and transverse processes of the vertebræ, especially in the lower dorsal and lumbar regions

Fractures of the bodies of the vertebræ are due to hyperflexion Fractures of the transverse processes are due to direct violence

The bodies of the vertebræ may be comminuted or a simple wedging may result from the collapse of the upper part of the anterior wall. In fracture-dislocations a fragment is often torn off the upper anterior lip of the lower vertebra by the slipping forwards of the body immediately above.

The history the localised pain and tenderness and the visible or palpable prominence of the affected spinous process suggest a fracture The anvil' test percussion of the spinous process is very helpful This is confirmed by lateral and anterior X ray plates

Treatment

First Aid—Every patient with a suspected fracture of a lumbar or dorsal vertebra is placed and transported in the prone position Fractures of a cervical vertebra are placed in the supine position with gentle traction on the head

Reduction—The patient, wearing a stockinette vest, is placed on an operating table, face downwards A stout 4-inch band is passed under his chest, and connected to an overhead block and tackle. By this means the shoulders and chest are gradually

raised off the table, thus hyperextending the spine. The end of the table is then let down (Fig 161) If the patient has been given a suitable injection of omnopon and scopolamine, this position is tolerated and anæsthesia is unnecessary This procedure is sufficient to reduce the fracture without manipulation in most cases Pressure on the spine may be necessary before reduction is achieved If a block and tackle

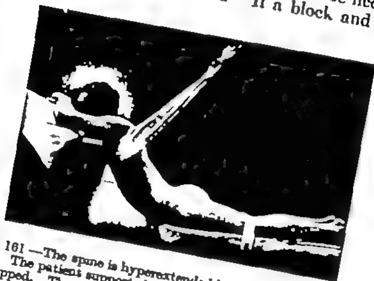


Fig 161 —The spine is hyperextended by a band with block and tackle The patient supports himself on a padded chair The legs are strapped. The stockinette vest in this case has been omitted.

are not available hyperextension can be obtained by suspending the patient between two tables The patient is positioned as described and then the table is tilted so that the part under the patient's thighs is lowered that is into the Trendelenburg position. If possible a lateral X ray is taken after manipulation

Pads of wool, which when compressed are ¼ inch thick, are applied over the iliac crests A pad ¼ inch thick, is placed along the length of the spine The pads are maintained in place by a gauze bandage A plaster jacket is then applied

Method.—Eighteen 6-inch bandages are required Four circular bandages are applied Over these four vertical slabs are placed—an anterior extending from the sternal notch to the front of the pubis two lateral from the axillæ *to below the iliac crests* and one *posterior* from the first dorsal spine to the natal cleft The slabs are fixed by four more circular bandages Two long slabs are applied round the upper and lower borders of the cast, which is completed with *four circular bandages The cast is moulded accurately* over four regions—the lumbar lordosis the upper sternum the symphysis pubis and the iliac crests It is trimmed to allow free arm movement and flexion at the hips to 90 degrees. The edges of the stockinette vest are turned down and fixed with plaster cream or an additional bandage The plaster is allowed to set the traction released and the extension band removed

Fractures of the cervical region are treated in a plaster jacket applied while traction is maintained on the head The cast is moulded to the lower borders of the mandible and the occipital bone Padding round the neck is essential. Cervical fracture dislocations need skeletal traction applied to the skull

The patient who has been treated thus should get up at the end of a week. Then he is encouraged to take as much exercise as possible preferably in a massage or rehabilitation centre Exercises at first are gentle, such as straight leg raising with the patient lying down He is taught to carry weights on his head and to put both upper and lower limbs through their full range of movement twenty times daily Later the patient lies face downwards and lets his trunk flex forwards over a table with his legs held, until he can almost touch the floor then slowly rises to the horizontal position again The period of immobilisation is from four to six months

Patients whose occupations are sedentary go back to work while in plaster Those engaged in heavy work may not be able to return to it for many months

Complications

1 *Fracture-dislocation*.—If manipulation fails operative measures may be indicated Paraplegia is common Every case of a fracture of the spine must be examined for this complication

2 If a fracture has been "missed" or the fixation discontinued too soon *Kümmel's disease* results (Fig 102) This is simply a gradual increase in the wedging of the vertebra due to the body weight above the fracture It is associated with aching pain in the back at the level of the injury The treatment consists of immobilisation of the spine in a plaster jacket as above, for four to six months Spinal fusion may be necessary



FIG 102.—Kümmel's disease. Note that only the upper surface of the vertebral body is compressed.

Fractures of the Transverse Processes.—These are treated by early active exercises, and physiotherapy or injection of novocaine

PELVIS

1 **Above the Acetabulum (False Pelvis)**.—(*a*) Fractures of the blade of the ilium are due to direct violence They are treated by rest in bed for three weeks. A binder is applied if the fragments are displaced laterally The prognosis is good

(*b*) Fractures of the anterior superior spines are due to direct violence If displaced markedly they are pegged in position by open operation.

2. **Below the Acetabulum (True Pelvis)**.—(*a*) The ischial tuberosity or one of the pubic rami is fractured as a

result of direct violence The patients are kept in bed until the acute tenderness has disappeared, and are then encouraged to walk.

(*b*) Fractures of the lower part of the sacrum and the coccyx are usually the result of direct violence, e.g. kicks, falls, or parturition.

The patient complains of pain when sitting or on any movement of the pelvic diaphragm, such as defæcation. Rectal examination is important.

Treatment.—The patient is confined to bed until the acute symptoms disappear, which usually takes a fortnight. If pain persists in spite of local measures such as diathermy, it may be necessary to excise the coccyx, but this should only be done as a last resort, as the results are not always satisfactory.

3. **Fractures involving the Acetabulum.**—Occasionally the head of the femur is driven inwards, thus fracturing the acetabulum. This is reduced by exerting powerful traction on the lower limb while the pelvis is fixed. If possible, a Hawley table or Anderson's well leg traction is used. A lateral pull is exerted by means of a roller towel passed round the upper third of the thigh. This, with the longitudinal pull, reduces the central dislocation of the head of the femur and the fragments of the acetabulum are replaced.

Fissured or star-shaped fractures of the acetabulum may occur. They are diagnosed by X-rays, and the patient is allowed up at the end of three weeks.

In dorsal dislocations of the head of the femur the posterior lip of the acetabulum may be broken. The dislocation is easily reduced, but readily recurs. It is treated by extension as in the case of complete fractures of the pelvis. Traction is maintained for at least twelve weeks.

4. **Fracture-dislocations of the Symphysis Pubis.**—The wide gap which exists between the two parts of the symphysis and which of necessity causes subluxation of one of the sacroiliac joints is treated by a wide sling. This passes underneath the pelvis, crosses over the abdomen to the opposite side, and is slung over a Balkan beam on either side by means of weights and pulleys.

5. **Where the bony ring of the pelvis is broken,** both pubic rami are involved, together with a vertical fracture usually

through the posterior part of the ilium lateral to the sacro-iliac joint, and sometimes on the opposite side of the pelvis.

The lateral fragment is displaced upwards carrying with it the lower limb

The patient is shocked unable to stand and suffers from severe pain Any movements of the limb on the affected side are very painful, and should be performed gently to avoid injuring the soft tissues An X ray confirms the diagnosis (Fig 163)



Fig 163.—The ilium is fractured just lateral to the right hand iliac joint; it is displaced upwards. On the left side the rami of the pubis are broken. The symphysis is dislocated.

Treatment —A Steinmann's nail is driven through the crest of the tibia and the patient put to bed on a Braun's splint (see Method p 323) A stirrup is attached to the nail and ten pounds traction applied by a cord which passes over a pulley on a Balkan beam (Fig 168) If both sides of the pelvis are fractured two Braun's splints and a double Balkan beam are used The foot of the bed is elevated on blocks to provide counter traction

Complications —These are mainly injuries to the soft parts e.g the urethra, bladder rectum, and vagina. *As a preliminary to any treatment in fractures of the pelvis a catheter must be passed.* This is necessary to exclude rupture of the urethra or bladder If hæmorrhage is occurring from the urethra but a catheter can be passed and clean urine obtained the diagnosis of a partial rupture of the urethra is made and a soft rubber catheter tied in. On the other hand if it is impossible to pass a catheter rupture of the urethra is present and an open operation for suture indicated The patient is warned not to pass urine so as to limit extravasation. If no hæmorrhage occurs from the urethra a catheter is passed to test for a ruptured bladder



FIG. 164 —Impacted fracture of the femoral neck. Note the abduction or coxa valga.

FEMUR

Fractures of the Neck — These may be close to the head through the middle of the neck, or at its base. The lower fragment may be adducted or ab-

ducted in relation to the upper

Abduction fractures (coxa valga) are impacted They result from a fall on the greater trochanter (Fig 164)

In adduction fractures (coxa vara) the violence is indirect, and the fragments are rarely impacted The patient lies with the leg in external rotation There may be an inch or more of shortening the iliotibial band is slack The greater trochanter is above Nelaton s line and the base of Bryant s triangle is shortened X ray photographs in two planes are essential.



Fig 165 —A short plaster spica. Note the moulding over the iliac crests and trochanter

Treatment

Abduction Fractures —The fracture is treated by means of a close-fitting short plaster spica (Fig 165), and the patient is encouraged to walk from the beginning No attempt is made to reduce the fracture, as the impaction will be broken down, and the fracture turned into the much more serious adduction type.

Adduction Fractures —If old or shocked the patient is put to bed on a Braun s splint with twelve pounds traction on a pin through the crest of the tibia until the acute symptoms have disappeared A Smith Petersen pin is then inserted.

Method —A linen bandage is wrapped firmly round the oblique and upper horizontal bars of a Braun s splint. The bandaging begins at the proximal end and is made bow-string

tight as far as the angle of the splint. A clip holds the tension here temporarily The bandaging is continued loosely for three turns along that part of the horizontal bars where the calf will rest (Fig 166) Another temporary clip is applied. Finally the bandaging is continued tightly to within 2 inches of the vertical upright. The bandage is sewn along the margins of the bars on both sides

The limb is laid on the splint which rests on a "fracture bed" that is a bed in which boards have been placed under the lower half of the mattress

The region of the tibial tuberosity into which the patellar tendon is inserted is made surgically clean by ether soap and

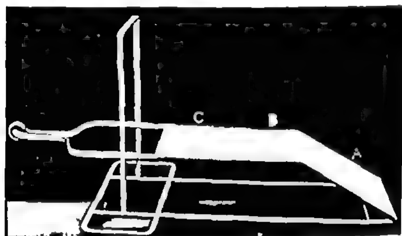


Fig 166.—The oblique bars of the splint are bandaged very tightly at A, to support the thigh. The bandage is applied loosely at B to allow for the contour of the calf It is tightly applied again at C for the leg

Dettol The leg is elevated and the surgeon places a sterile towel along the splint, on to which the leg is lowered. Two more towels are placed transversely across the leg so as to leave exposed the tibial tuberosity

Five cubic centimetres of 2 per cent. novocaine are injected into the tissues down to the bone on either side, ½ inch behind the tubercle The point of the Steinmann's nail is pushed through the anæsthetised skin down to the bone of the tibia (Fig 167) Then it is pushed or preferably hammered

through, until it appears at the outer side A dressing of mastisol and balsam of Peru on wool covers the junction of nail and skin

Böhler s U-shaped stirrup is then fixed to the nail This allows movement between it and the nail without any movement taking place between the nail and the bone

Many other types of stirrup and Kirschner wire suffer from the great disadvantage that if movement occurs the nail or wire must rotate in the bone This encourages sepsis

Morrison s type of Balkan frame is the best (Fig 168) It is made from gas piping and can be assembled and dis-



Fig 167 —The nail is lowered to the horizontal and driven through by means of a hammer

mantled easily A cord is fixed to the stirrup and brought over a pulley on the Balkan frame and the weights are attached The line of pull must be in the line of the femur Another cord is then tied to the outer part of the nail and the horizontal cross-bar of the overhead frame By tightening the cord, external rotation is controlled

In order to prevent foot-drop a piece of 3-inch strapping is placed along the sole of the foot, painted with mastisol, and fixed by a gauze bandage. The upper end of the strapping is then fixed to the horizontal cross-bar of the Braun s splint or to a weight over a pulley on the Balkan beam. The splint and Balkan beam are abducted to the desired angle then the splint is fixed by cord to the foot of the bed

Counter traction is obtained by the body weight It is

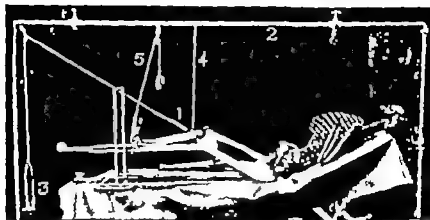


FIG 168.—1 U-shaped tractor or stirrup 2. Morrison's frame. 3 Spain's type of weight hanger and weights. 4 Cord controlling external rotation. 5 Cord and weight preventing drop-foot.

made to act by elevating the foot of the bed on blocks from 12 to 24 inches high, so that the patient tends to slip along the inclined plane towards the head of the bed. The middle of the patella must be opposite the angle of the splint except in supracondylar fractures of the femur A box is placed between the sound foot and the end of the bed By pushing against this the patient can regulate his position He is encouraged to sit up on a bed rest and move as much as the position allows These movements reduce the risk of embolism and chest conditions

Adduction Fractures in healthy patients are reduced and fixed by a Smith Petersen pin or bone graft as soon as circumstances permit. The fracture is reduced by Leadbetter's method. The knee and hip are flexed and moderately powerful manual traction maintained Then the thigh is internally rotated and extended The heel is allowed to rest on the palm of the hand and if the fracture has been reduced, the foot will remain vertical If not reduced it will roll out into the position of *external* rotation The reduction is best carried out on some type of extension table such as a Hawley table The position is then

fixed and a Smith Petersen nail, or bone graft, or a combined nail and graft inserted

Intertrochanteric Fractures.—These are caused by a fall on the greater trochanter The lower fragment is displaced upwards and externally rotated

The history tenderness in the region of the greater trochanter and shortening of the limb, all indicate the diagnosis, which must be confirmed by an X ray

The patient is treated on a Braun s splint, in wide abduction with "twelve pounds for twelve weeks" In old people a much longer period, even up to five months, of immobilisation may be necessary otherwise when weight bearing is begun a coxa vara develops

Supracondylar Fractures and Fractures of the Shaft.—These fractures are treated on a Braun's splint,

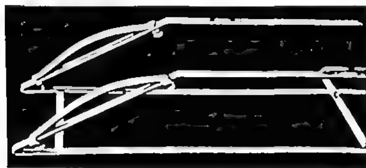


FIG 169—The anterior curve of the femur is maintained by fitting bows to the oblique bars of Braun s splint The splint is padded in the usual way

with skeletal traction through the crest of the tibia. To prevent backward bowing and preserve the natural bend of the femur a modified Braun's splint is used (Fig 169) A heavy weight may be used for a short time, but should never be allowed to cause separation of the bone ends Russell traction may

be helpful (Fig 170) The lower fragment is flexed by the pull of the gastrocnemius If the angulation is not reduced, the fragments are manipulated while traction is maintained Care is taken not to injure the popliteal vessels which are stretched over the upper edge of the lower fragment. In

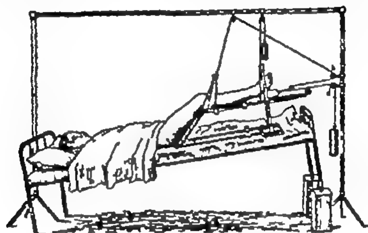


Fig 170

fractures of the shaft with overlap the hinge method of reduction (Fig 144) may be used When angulation and shortening have been reduced exact anatomical apposition is not necessary in fractures of the femur Supracondylar fractures are immobilised for eight weeks fractures of the shaft require twelve weeks' fixation

Vertical or oblique fractures into the knee joint require special treatment. If one condyle is displaced upwards, an attempt is made to reduce it by forcible angulation with the knee in full extension If the collateral ligament is intact, the fragment is pulled downwards The limb is then plastered in the corrected position Where the vertical limb of the fracture is a wide gap the condyles are compressed with a Thomas's wrench or a Böhler's redresseur Fixation is maintained for eight to twelve weeks

Separation of the Lower Femoral Epiphysis.—If manipulation fails, the separation is treated on the lines laid down for supra condylar fractures

Fractures of the Femur in Children

1 Up to the age of four these are treated by means of a gallows splint (Fig 171)

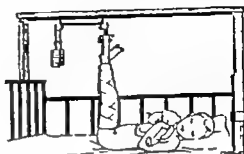


Fig 171 —Gallows splint.

Strapping extension is applied to the lower limbs from groin to ankle A wooden spreader separates the strapping below and to it is attached a cord which passes over a pulley on the gallows Sufficient weight is attached to the cords to lift the child s buttocks just off the bed It is important to have an X ray of this fracture after ten days as the clinical appearance is most deceptive If the position is not satis factory the limb is manipulated under an anæsthetic, and a plaster applied over the strapping extension to maintain the correction

2 Children *over four* are best treated on small Braun s or bent Thomas splints with strapping extension

The strapping is applied in two parts the first to the thigh as far as the knee the second to the leg from knee to ankle. The strapping is fixed by one layer of gauze bandage over which mastisol is painted This prevents the strapping from slipping A wooden spreader is applied to the strapping so as to separate the two strips. To these spreaders cords are attached and brought over pulleys on the Morrison s frame care being taken to have the traction in the line of the femur and tibia respectively Weights of 4 lb are attached to the ends of the cords The end of the bed is elevated on 10 inch blocks

Patella

With direct violence the typical stellate fracture occurs without separation of the fragments Indirect

violence causes separation of the fragments as the lateral expansions of the quadriceps at the sides of the patella are torn. Separation is palpable, and the patient is unable to extend the knee. In other cases the history, the tenderness over the patella and the effusion into the knee joint point to the diagnosis. An X ray is confirmatory. A separate centre of ossification in the upper outer quadrant must not be mistaken for a fracture.

Treatment

1. Where there is no separation, but a large effusion, the blood is aspirated from the joint under rigidly aseptic conditions. A thick layer of wool is then *wrapped round the knee, and over this a domette* bandage is applied firmly. The patient is encouraged to move the knee gently and is allowed up at the end of a week. At the end of three weeks an X ray is taken, as in a small percentage of these cases where the expansions are partially torn in the first instance, separation of the fragments may occur. If this happens, the case must then be treated as one of separation.

2. Two methods of treatment are employed when the fragments are widely separated.

(*a*) The lateral expansions are accurately repaired with catgut. Frayed periosteum is excised from the edges of the broken bone. The two fragments are approximated by stout catgut sutures passing through the quadriceps expansion on the anterior surface of the patella and through the bone fragments. Passive exercises are begun after three weeks. Weight bearing is allowed when the patient can raise the limb voluntarily from the bed.

(*b*) The patella is excised, the fragments being removed completely. The edges of the quadriceps expansion are approximated over the front of the joint with catgut. The skin is sewn with silkworm

gut sutures This method should only be employed when the patella has been extensively damaged (Fig 172) When small pieces have been torn off above or below, these may be removed to facilitate suture.

Those patients whose injury is due to direct violence can return to heavy work at the end of two



FIG 172.—Damage to the patella sufficient to warrant excision.

months other cases when a satisfactory range of movement and power have returned i.e when the patient can lift twenty pounds with the knee extended

TIBIA

1 **Upper End.**—A fracture of one tuberosity is due to forced abduction or adduction of the knee joint. The lateral tuberosity is more commonly involved, due to the prevalence of the so-called 'bumper' fracture. When the outer side of the knee is struck violently

as with the bumper of a car the lateral femoral condyle is driven downwards *on to the outer tuberosity of the tibia*

The tuberosity is displaced downwards, and rotated so that its upper surface slopes downwards and outwards Occasionally the upper articular *plate of the tuberosity* is impacted into the *cancellous* bone of the tibia (Fig 173)



Fig 173 —"Bumper fracture

Anatomical reposition of these fractures is extremely difficult.

Treatment

1 In the old patient or in minor degrees of displacement, treatment consists of early active exercises in bed Weight bearing is *not allowed* for two months

2 In the young, with marked displacement, open reduction and wiring the fragments are necessary A curved incision is made on both sides of the joint. Under direct vision the fragments are elevated Two holes are drilled through the head of the tibia a wire is passed through them, and tautened with a wire tightener on the inner side of joint (Capener) Exercises are carried out while 7 lb traction is maintained for two months

If both tuberosities are broken, strong skeletal traction through the os calcis or tibia is usually successful in reducing the levels of the tuberosities The fracture is then wired as described

1 *Joint Stiffness* —This usually disappears after a short time if exercises are performed regularly

2 *Deformity* —If severe genu valgum or varum results arthrodesis of the knee may be necessary

TIBIA AND FIBULA

Shafts.—When the violence is direct, the fracture i usually transverse, when indirect, oblique

The history unnatural mobility deformity and :nderness make the diagnosis obvious

In all cases with displacement a Steinmann s il is inserted through the os calcis Böhler's shaped stirrup is fixed to the nail. The limb is placed in Böhler's screw traction apparatus (Fig 174) By means of the screw the traction is increased until the bone ends are felt in accurate apposition The bone ends must *never* be overpulled or gangrene may result This is verified by X rays The leg and foot are then incorporated in a skin tight plaster

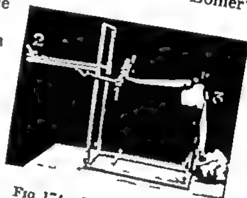


Fig 174 —Böhler screw traction apparatus. 1 Nail through os calcis, attached by stirrup to hook. 2. Screw and wing nut. It is advisable to insert a spring balance to control traction 3 Knee flexed to right angle over counter traction stop with a sorbo and large wool pad.

Method —A slab is made from a 6 inch bandage. It extends from one tuberosity of the tibia round the heel, to the other tuberosity It is folded on itself to form a 3 inch slab and applied in the form of a U (Fig 180) and is incised to fit round the Steinmann s nail The slab is maintained in position by a 6-inch gauze bandage 6 yards long A second anterior plaster slab 6 inches wide, is made so as

to extend from the web of the toes, in front of the ankle to the knee The edges of the plaster in front of the ankle are incised Two 6-inch plaster bandages are then applied circularly When the plaster has set, the limb is removed from the screw traction apparatus and laid on a properly padded Braun's splint (Fig 166) A weight of 7 lb is attached by a cord to the U shaped stirrup The foot of the bed is elevated on 12 inch blocks. The limb is placed in the screw traction apparatus again at the end of three weeks The plaster is removed and a new one applied The os calcis nail is removed and the plaster elongated to the upper third of the thigh before weight bearing is allowed In oblique fractures, nails are inserted through the crest and the lower third of the tibia A new plaster is applied incorporating the nails A rubber heel is made from two ½-inch pieces of sorbo rubber cut to the shape of the heel and held with an elastoplast or a plaster bandage

In a transverse fracture through the middle third, union may be delayed The other fractures of the tibial shaft have joined usually at the end of two or three months

Fractures of the Leg Bones in Children.—No distraction is needed in these cases Adequate reposition can be obtained by manipulation, and the position may be maintained by a skin tight plaster as above. Children are not allowed to walk for three weeks These cases have united as a rule at the end of two months

While these patients are ambulatory they should be encouraged to do light work and exercises

Non union occasionally occurs in transverse fractures through the middle of the tibial shaft. It may occur in any compound fracture of the tibia where much bone has been removed at operation, or where sepsis has intervened Non union is treated by either "onlay" or "chip" grafts

FIBULA

1 **Shaft, and Upper End.**—The history, site of the tenderness, and pain on "springing" the fibula make the diagnosis simple. To "spring" the fibula, it is compressed towards the tibia at some distance from the suspected site of the fracture. An X ray is confirmatory

No reduction is necessary If pain is slight, an elastoplast bandage is sufficient. If pain is severe, a walking plaster is indicated or the site of the fracture may be injected with 5 to 10 c c. of 2 per cent. novocaine.

Patients are encouraged to use the limb from the beginning Heavy work may be resumed after a month to six weeks

A fracture of the neck of the fibula may involve the common peroneal nerve, with resulting foot drop

2 **Lower Third without Displacement.**—Tenderness and swelling are present over the site, and after a few days the discoloration of a hæmatoma on the dorso-lateral aspect of the foot will be noticed An X ray is taken in every case.

Treatment

Below the Ankle-joint Level—An elastoplast bandage to include the ankle joint is sufficient, and the patient is incapacitated for only a few days The injection of 5 c c. of 2 per cent. novocaine into the fracture hæmatoma relieves the pain. Rarely pain is severe and a walking plaster necessary

Above or at the Ankle Joint.—If the internal lateral ligament is torn a skin tight walking plaster is always indicated Occasionally even in plaster displacement may occur If the internal lateral ligament is intact, 5 c.c. of 2 per cent. novocaine are injected into the fracture hæmatoma, and the patient encouraged to walk without any immobilisation.

Test for Torn Internal Lateral Ligament.—The ligament is palpated for deep tenderness The heel is then grasped and forced laterally in eversion If no pain or lateral mobility is noticed, the ligament is intact.

Lower Third with Displacement—These fractures must be reduced accurately even if the deformity is slight (see Pott's Fracture)

FRACTURES INVOLVING THE ANKLE JOINT WITH MARKED DISPLACEMENT

1 **Abduction External Rotation Fracture**—The patient slips everts and externally rotates the foot forcibly The foot is displaced laterally and backwards The fibula is broken obliquely above the lateral malleolus The internal lateral ligament is torn and its malleolus intact or the malleolus fractured and the ligament intact (Fig 175)

2 **Adduction Fracture.**—The patient slips in such a way that the foot is inverted The astragalus



FIG 175—Pott's fracture The medial malleolus has broken at the joint level The internal lateral ligament is intact



FIG 176—After reduction the tibial joint line has been accurately reconstituted.

is forced inwards against the medial malleolus, which is broken close to the joint level The lateral malleolus follows the astragalus and breaks where it joins the shaft of the fibula

3 **Dupuytren's Fracture**—In this fracture the fibula is broken just above the lateral malleolus The interosseous tibio-fibular ligament is ruptured, and the tibia and fibula are separated by the astragalus which is driven upwards between the two bones.

The history the pain, swelling and tenderness in the ankle joint region, together with the deformity resulting from the displacements above described, indicate the diagnosis An X ray photograph is essential.

Treatment.—The patient is anæsthetised on a firm table. The knee is flexed to a right angle over the end of the table so that the foot hangs downwards The surgeon sits on a stool so that the affected foot can rest comfortably on his knee.



FIG 177—The left hand steadies the leg The right hand grasps and pulls the heel forward. The forearm lies under the sole and dorsiflexes the foot.

One hand grasps the lower third of the leg The heel is gripped firmly with the other hand The operator's forearm lies along the sole of the foot (Fig 177) Pressure is exerted *medially* to reduce the lateral displacement. If the medial malleolus is broken off flush with the lower articular surface of the tibia, too strong pressure may over-correct the deformity The foot is forcibly pulled forwards to correct the backward displacement. If the pos

terior edge of the tibia has been broken and displaced upwards, this correction is maintained, and the foot is strongly dorsi flexed by forcing the forearm upwards against the sole During these manœuvres the



Fig 178 —Anterior marginal fracture with forward and upward displacement



Fig 179 —Same case as Fig 178 reduced by pin traction.

passive or ' leg hand maintains counter pressure to the active or foot hand.

In adduction fractures *lateral* pressure is necessary to reduce the medial displacement.

Screw traction may be necessary for Dupuytren s fracture or for fractures of the anterior or posterior margins of the tibia (Figs 178 and 179) When the

astragulus has been replaced, strong manual compression of the lower ends of the tibia and fibula is necessary

Fixation—A plaster slab long enough to reach from the lateral tuberosity of the tibia, round the heel, to the inner tuberosity is made from a 6-inch bandage, 6 yards long It is folded on itself so that the width is 3 inches This is applied to the medial and lateral surfaces of the leg and under surface of the heel (Fig 180) The slab is fixed by a gauze bandage which is 6 yards by 6 inches Another posterior plaster slab, long enough to reach from the knee along the posterior surface of the leg and the back of the ankle to the tip of the toes, is made from a 6-inch bandage 6 yards long The edges are incised on either side at the heel Two circular plaster bandages of similar measurement are applied The bandaging begins above, and two fingers breadth separates the tops of the turns The position of reduction must be carefully maintained until the cast has set.



FIG 180—The plaster loop made from a 3-inch slab is in position along the inner and outer aspects of the leg

The patient is put to bed on a Braun s splint for twenty four hours. The foot of the bed is elevated on 12 inch blocks to discourage swelling

When circulatory troubles have been obviated, a walking heel is applied

A *plaster* heel is simply a plaster bandage which is partially unwound and fixed beneath the heel

A *rubber* heel is made from two pieces of ½-inch sorbo rubber as wide as the sole of the cast and one third its length. The pieces of rubber are bound together by a few turns of



FIG 181 —The upright bar of the iron heel is in the line of the leg It must not tilt backwards or forwards.

the plaster bandage and then fixed in position with the remainder or with elastoplast when the plaster has dried

An *iron* heel is applied exactly in the line of the leg and not tilted backwards or forwards (Fig 181) It extends 1½ inches below the plaster A turn of a 6-inch plaster bandage is taken round the anterior cross bar The bandage then passes behind the calf to the anterior part of the opposite cross-bar thus forming a posterior sling An anterior sling is formed by reversing this manoeuvre The soft cross-bars are moulded firmly against the cast and two turns of the bandage fix them The bandage is continued down the leg around the iron shaft to the ankle The attenuated bandage is passed through the loop of the iron and anterior and posterior slings are again formed, care being taken to ensure that the iron is still in the line of the leg Preferably these heels are made from duralumin to avoid X ray difficulties

A control X ray is taken before an opaque iron heel is applied and check X rays are taken at the end of each month

The plaster is retained for three months During this period the patient is encouraged to carry on with his normal duties as far as possible

Os Calcis

There are eight types of os calcis fractures (Böhler)

The common cause of the injury is a fall from a height on to the heels, or violent impact from below as in a torpedoed ship

Displacement.—The bone is broadened due to a longitudinal fracture and downward compression The tuber joint angle is decreased

The history of a typical injury, and the broadening and tenderness in the region of the os calcis are diagnostic. An X ray must be taken in two planes, lateral and axial



Fig 182 —"Duck bill" fracture of os calcis.

Treatment

1 The duck bill fracture (Fig 182) needs open operation to reduce the displaced fragment (Fig 184) Active movements are started when the stitches have been removed

2 All other types have immediate treatment This consists of heat massage and active exercises especially inversion and eversion These latter movements are helped greatly by alternating



Fig 183 —Girdlestone walking irons to allow subastragaloid movement.

faradism When the swelling has been massaged away the broadening of the os calcis is reduced by a redresseur *Weight bearing is not* allowed for three months To be confined to bed for three months on account of this injury is very *irksome* To overcome this a plaster and iron heel has been devised by Girdlestone (Fig 183) This allows the patient to be ambulatory and does not limit subastragaloid *movement*



Fig 184 —" Duck bill fracture reduced.

3 In type 6, where the subastragaloid surfaces are no longer in apposition (Fig 185) reduction is necessary as well as clamping (Fig 180) If this fails arthrodesis is indicated

Astragalus

Fractures of the astragalus without displacement are treated in a walking plaster for six weeks Where displacement is present it should be reduced by manipulation or if necessary by means of the screw traction apparatus If the fracture is at the



Fig 185 —Type 6 os calcis fracture *The upper surface articulates with astragalus only at its extreme upper tip*



FIG 186 —Same case as Fig 183 Reduced by a back pin.



FIG. 187 —Tarso-metatarsal dislocations. All the metatarsals are displaced laterally



FIG 188 —Same case as Fig. 187 The bases of the metatarsals have been reduced. The wire is too low in the fourth metatarsal.

junction of the head and neck, the foot is maintained in plantar flexion in plaster for three weeks, and then in a walking plaster with the foot at a right angle for six weeks

Other Tarsal Bones.—These are treated in a walking plaster for six weeks followed by a course of radiant heat and massage

Metatarsals

The violence is direct, with the exception of the base of the 5th metatarsal, and occasionally the necks of the 2nd and 3rd metatarsals where the violence is due to a twist of the foot.



Fig 189.—March fracture at neck of the second metatarsal. No history of injury



Fig. 190.—Fracture of the distal phalanx of the great toe Hallux rigidus at metatarso-phalangeal joint

The history, and the tender spot which is present on palpation over the fracture site are indicative of the diagnosis An X ray photograph is always taken, even when there is no history of injury as there may be a march fracture present (Fig 180)



Fig 101 —The upper edge of the plaster shoe follows the lines of a walking shoe Ankle movements are free

When the arch of the metatarsals is grossly displaced or in tarso metatarsal dislocations (Fig 187) reduction is necessary This is accomplished by means of distraction, using a nail through the os calcis and a fine wire through the necks of the metatarsals (Fig 188) with Böhler s upper limb traction apparatus Where the deformity is slight, but pain severe, a plaster shoe (Fig 101) is applied and retained for two weeks then an elastoplast bandage is applied for three weeks

When the plaster has been removed these patients are put on a vigorous course of exercises such as sculling cycling and skipping If necessary, physiotherapy is prescribed If swelling is severe, exercises on an inverted friction bicycle or Mennell s treatment (faradic stimulation of the calf muscles under a firm Esmarch bandage) are helpful

These patients should be able to return to heavy work in three months

PHALANGES

The swelling tenderness and hæmatoma at the site of the injury are usually diagnostic An X ray is confirmatory (Fig 100)

Where no displacement is present, the toe is

strapped (Fig 102) Where gross displacement is present, it is reduced by manipulation and immobilisation in plaster Where pain is very severe, and the toe very swollen, this is usually due to a hæmatoma under the nail It is treated by boring a small hole through the nail This is best done by a rotatory



FIG 102 —Narrow pieces of strapping, which interlock along the dorsal aspect of the toe are used for phalanges of feet and hands.

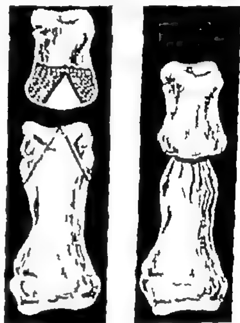


FIG 103 —Hing a spike arthrodesis. An awl is used to bore a hole in the base of the phalanx. The spike is fashioned with small bone forceps.

movement with a straight-cutting needle held between finger and thumb (Griffiths) a plaster shoe (Fig 101) is then applied for ten days

These patients are able to return to heavy work in two months

Complications

1 Limitation of movement is treated by a course of massage and toe stretching If this fails manipulation is performed

2. Persistent pain often follows fractures involving the

interphalangeal joints It is treated by arthrodesis Higgs spike operation is the best procedure (Fig 103)

Ribs

These fractures are caused by direct, indirect, or muscular violence In some nervous diseases, e g tabes very slight trauma may cause a fracture of the rib. One fragment may be driven inwards and injure the underlying structures



Fig 104.—Six-inch wide strapping being applied over lower ribs Both sides of the chest are strapped.

The history, signs of local trauma, and pain referred to the fractured site when the chest is gently compressed antero-posteriorly indicate the diagnosis Deep breathing or coughing causes pain at the site of the injury

Treatment —The patient sits on a stool with his back to the surgeon, who passes a piece of 6-inch wide strapping around the front of the patient's chest at the level of the lower ribs (Fig 104) The patient takes a deep breath, exhales fully and holds his

strapped (Fig 192) Where gross displacement is present, it is reduced by manipulation and immobilisation in plaster Where pain is very severe, and the toe very swollen, this is usually due to a hæmatoma under the nail It is treated by boring a small hole through the nail This is best done by a rotatory



Fig 192 —Narrow pieces of strapping, which interlock along the dorsal aspect of the toe, are used for phalanges of feet and hands.

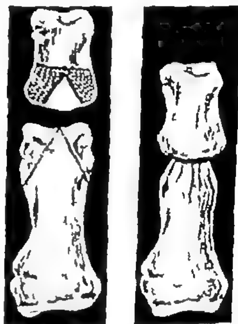


Fig 193.—Higg's spike arthrodesis. An awl is used to bore a hole in the base of the phalanx. The spike is fashioned with small bone forceps.

movement with a straight cutting needle held between finger and thumb (Griffiths) a plaster shoe (Fig 191) is then applied for ten days

These patients are able to return to heavy work in two months

Complications

1 Limitation of movement is treated by a course of massage and toe stretching If this fails manipulation is performed

2 Persistent pain often follows fractures involving the

into the tissues If a general anæsthetic is given, nitrous oxide and oxygen are used

A strip of skin ⅛ inch wide, is excised from the wound edge. The wound is then carefully examined, and any damaged tissues which may die if left, are removed Dirty bone chips are removed Any large clean pieces of bone, however, must be retained or non union may result. When it is certain that all dead or dying tissues have been removed, a fine catheter or piece of rubber tubing for penicillin is placed in the wound and fixed to the skin by a suture and the skin is sutured with loosely placed interrupted silkworm-gut stitches Severe wounds are left open and packed lightly with glycerine and sulphathiazole

The fracture is now treated as a closed one, and the technique described for the various bones is carried out Penicillin is introduced through the fine rubber tube during the early stages Full doses of penicillin are continued until approximately a million units have been given The plaster if possible, is not changed for at least one month

After treatment.—If a lower limb is involved it is placed on a Braun s splint, and the procedure for simple fractures followed

Complications —If gas gangrene develops, energetic treatment by sulphonamides and penicillin must be employed Incisions into the infected part may be required, and occasionally amputation Anti gas gangrene serum may also be employed

DISLOCATIONS

Inspection

Deformity is usually obvious

Signs of local trauma bruising and swelling may be present.

Alteration in length of the limb is common. In dorsal dislocation of the hip joint there is shortening

breath While the chest is thus in a position of expiration, the ends of the strapping are fixed along the back of the chest so as to overlap and the patient allowed to breathe again To strap one side, or the upper part of the chest, is ineffective If the upper ribs are involved, a second piece of strapping is applied as an oblique shoulder strap on the affected side.

If the fragments are depressed, strapping is not applied, but the patient propped up in bed and operative treatment undertaken if necessary

Compound Fractures

The severity of the fracture depends on the injury When the violence is direct, such as a wheel going over a leg and crushing the skin and soft tissues as well as the bone, the injury is obviously more severe than in the case of indirect violence In the latter the bone end merely pierces the skin from within and may not come in contact with any external object.

Emergency operation is indicated and the choice of anæsthetic depends on the general condition of the patient.

General Treatment.—Every compound fracture must be given adequate doses of penicillin with A T.S and anti gas gangrene serum and chemotherapy if necessary If the patient is very shocked operative procedures are delayed for a short time while the usual resuscitative measures are employed

Local Treatment.—If shock is prolonged, a local anæsthetic, freshly sterilised 2 per cent. novocaine, is used The skin edges are carefully cleansed with ether soap, and painted with Dettol A 10-c c syringe and long fine needles are used The subcutaneous tissue is injected by a series of punctures round the wound The fracture is anæsthetised by injecting 10 to 15 c c of 2 per cent novocaine between the bone ends This injection is not given through the wound but through intact skin, this avoids spreading infection

into the tissues If a general anaesthetic is given, nitrous oxide and oxygen are used

A strip of skin, ⅛ inch wide, is excised from the wound edge The wound is then carefully examined, and any damaged tissues, which may die if left, are removed Dirty bone chips are removed Any large clean pieces of bone, however, must be retained or non union may result. When it is certain that all dead or dying tissues have been removed, a fine catheter or piece of rubber tubing for penicillin is placed in the wound and fixed to the skin by a suture, and the skin is sutured with loosely placed interrupted silkworm-gut stitches Severe wounds are left open and packed lightly with glycerine and sulphathiazole

The fracture is now treated as a closed one, and the technique described for the various bones is carried out. Penicillin is introduced through the fine rubber tube during the early stages Full doses of penicillin are continued until approximately a million units have been given The plaster, if possible is not changed for at least one month

After treatment.—If a lower limb is involved, it is placed on a Braun s splint, and the procedure for simple fractures followed

Complications —If gas gangrene develops energetic treatment by sulphonamides and penicillin must be employed Incisions into the infected part may be required, and occasionally amputation Anti gas gangrene serum may also be employed

DISLOCATIONS

Inspection

Deformity is usually obvious

Signs of local trauma, bruising and swelling may be present.

Alteration in length of the limb is common. In dorsal dislocation of the hip joint there is shortening

whilst in obturator dislocation of the hip there is lengthening of the limb

Palpation

The end of the bone is felt in an abnormal position

Movement is limited in characteristic directions

Crepitus may be elicited, and suggests fracture.

Pain is severe from damage to capsule and ligaments Additional pain numbness, and tingling are caused by involvement of neighbouring nerves.

A dislocation is best recognised by comparing the two sides and by careful palpation of bony landmarks.

Complications

1 Fracture
2 Injury to vessels.
3 Injury to nerves
4 Compound dislocations

1 It is often difficult to diagnose a fracture without the help of radiography If the dislocation readily recurs after reduction this complication should always be suspected (see Fracture Section)

2 The remarks concerning injury to vessels complicating a fracture apply here

3 Injuries to nerves may occur and are complete or incomplete They differ from the complication in relation to fractures in that the symptoms are seldom delayed

4 The treatment of a compound dislocation is similar to that of a compound fracture once the dislocation has been reduced, except that active movements are instituted as soon as the wound has healed.

If possible drainage is avoided When it is necessary the drain is inserted down to, but not into the joint, except in very severe cases

Prognosis

Generally there is restoration of function if reduction is performed early Stiffness of surrounding

muscles, or late arthritic changes, however, must be remembered Fracture may prevent reduction or cause recurrent dislocation Callus formation may limit movement and even produce ankylosis Injury to nerves may cause paralysis of muscles, which delays the restoration of function Injury to vessels naturally affects the prognosis

In compound dislocations, if severe infection occurs, septicæmia, disorganisation of the joint, or ankylosis may follow

Treatment

The dislocation should be reduced as soon as possible.

(*a*) *Manipulation* —The object is to make the head of the bone retrace its course. Reduction may be accomplished sometimes without the use of an anæsthetic. An injection of ¼ gr of morphia half an hour before manipulation is useful

(*b*) *Traction* —This consists of tiring out the muscles by prolonged pulling so that replacement of the bone becomes possible

(*c*) *Operation* —This is indicated when the above measures have failed or if the dislocation is complicated by ruptured vessels or nerves, or by certain types of fracture

As a rule, reduction should not be attempted after eight weeks on account of the danger of tearing vessels and nerves or of fracture

Treatment of Unreduced Dislocations

This depends upon the age of the patient, his occupation, the amount of movement present, and whether it causes pain If the patient is elderly, or if there is sufficient painless mobility to allow him to follow his occupation massage and movements are advised

whilst in obturator dislocation of the hip there is lengthening of the limb

Palpation

The end of the bone is felt in an abnormal position.

Movement is limited in characteristic directions

Crepitus may be elicited and suggests fracture.

Pain is severe from damage to capsule and ligaments Additional pain, numbness and tingling are caused by involvement of neighbouring nerves.

A dislocation is best recognised by comparing the two sides and by careful palpation of bony landmarks.

Complications

1 Fracture
2 Injury to vessels
3 Injury to nerves
4 Compound dislocations

1 It is often difficult to diagnose a fracture without the help of radiography If the dislocation readily recurs after reduction this complication should always be suspected (see Fracture Section)

2 The remarks concerning injury to vessels complicating a fracture apply here.

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In compound dislocations, if severe infection occurs septicæmia, disorganisation of the joint, or ankylosis may follow

Treatment

The dislocation should be reduced as soon as possible

(a) *Manipulation* —The object is to make the head of the bone retrace its course Reduction may be accomplished sometimes without the use of an anæsthetic An injection of $\frac{1}{4}$ gr of morphia half an hour before manipulation is useful

(b) *Traction* —This consists of tiring out the muscles by prolonged pulling so that replacement of the bone becomes possible.

(c) *Operation* —This is indicated when the above measures have failed or if the dislocation is complicated by ruptured vessels or nerves or by certain types of fracture

As a rule, reduction should not be attempted after eight weeks on account of the danger of tearing vessels and nerves, or of fracture.

Treatment of Unreduced Dislocations

This depends upon the age of the patient, his occupation the amount of movement present, and whether it causes pain. If the patient is elderly or if there is sufficient painless mobility to allow him to follow his occupation, massage and movements are advised

Open operation is indicated in the young where a freely mobile joint is necessary or when pain is severe The most useful operation is partial excision After reduction the bone ends are maintained in the corrected position Recurrence of the dislocation is unlikely Exercises are commenced as early as possible.

Lower Jaw

Any act which causes the mouth to be opened too widely, such as excessive yawning, a blow, or dental extraction are the usual causes of mandibular dis location

The condyle of the mandible slips forwards under the articular eminence and becomes fixed in this position It is impossible to close the mouth fully The normal bite is altered There is pain in the region of the temporo-mandibular joint. The condyle of the mandible is palpable in the displaced position and a depression is felt behind it. The dislocation may be bilateral An X ray photograph is confirmatory

Treatment —The surgeon s thumbs are carefully bandaged They are introduced into the patient's mouth, and pressure is exerted downwards and backwards on the lower molar teeth.

After reduction care is taken not to open the mouth widely for a month

Clavicle

1 **Acromial End.**—The clavicle is displaced up wards from the acromion Both shoulders are examined together from the front. The displacement is obvious The fact that it can be reduced by lifting up the shoulder girdle and depressing the clavicle, clinches the diagnosis

Reduction is simple Maintenance of reduction without recourse to operation is very difficult.

Method.—Pieces of adhesive felt are placed on the outer end of the clavicle and the under surface of the olecranon The clavicle is pressed down firmly and a piece of strapping fixed over it and around the elbow as a circular sling

As the disability which follows this injury is not severe, and as the scar is unsightly, operation is seldom indicated

2 **Sternal End.**—The common displacement is forwards The rounded inner end of the clavicle is seen and felt in front of its usual position

Reduction is effected by pulling the shoulders backwards, and pressing dorsally over the displaced bone. Three slings are then applied as in fractures of the clavicle A thick pad of adhesive felt is placed over the end of the clavicle, and pressure applied on it by strips of elastoplast which pass obliquely across the root of the neck and opposite side of the chest. Fixation is maintained for a month Plaster of Paris may be necessary to maintain the position

Sometimes the bone must be anchored in place by operation, using a fascial sling (Bankart)

After a month the upper limb is exercised on overhead pulleys (Fig 128) The patient should be able to resume heavy work at the end of ten weeks

SHOULDER JOINT

1 **Simple Dislocation** is due to forcible abduction of the arm, levering the head downwards out of the glenoid cavity

2 **Recurrent Dislocation.**—Fairbank and Bankart have shown that this type is caused when the head of the humerus is forced forwards, as by a direct blow on the back of the shoulder The glenoid labrum is torn off anteriorly

In the simple type the head of the bone is first displaced downwards into the subglenoid position

It seldom stays here, but takes up the *subcoracoid*, or rarely the subspinous or subclavicular positions

Very exceptionally it is displaced posteriorly

Diagnosis

Inspection.—When both shoulders are looked at from the front, the normal rounded contour is absent (Fig 105)

Palpation.—Pressure is exerted with the fingers below the acromion process on either side On the



Fig 105.—Note the flattened outline on the right side due to an unreduced dislocation of the shoulder

affected side the resistance due to the head of the humerus is not felt. The head of the bone is prominent in the axilla or in the subcoracoid region

Mensuration.—The distance from the tip of the acromion to the prominence of the lateral epicondyle differs on the two sides

Ruler stick Method.—A ruler is placed along the lateral side of the arm On the affected side it will touch the tip of the acromion and the prominence of the lateral epicondyle

Treatment

Kocher's Method—The patient is anæsthetised Sufficient relaxation may be obtained by ¼ gr of morphia The surgeon stands on the affected side, grasping the flexed elbow with one hand, and the wrist with the other Gradually, using the forearm as a lever, the limb is externally rotated This position is maintained while the elbow is steadily brought across the chest towards the mid line (Fig 196) When the limit to this movement has been



Fig. 196—Kocher's method for reduction of a dislocated shoulder

reached the arm is gently rotated inwards, until the wrist comes in contact with the opposite clavicle A reversed dislocation may be reduced by a reversed Kocher's manœuvre, i e an internal rotation so that the hand ends behind the back

"Heel in Axilla"—The patient is anæsthetised as before. The surgeon grasps the wrist of the affected side in both hands and places his stockinged heel in the axilla Traction is exerted in the semi abducted position and gradually increased as the limb is brought down towards the affected side The heel pushes the head of the humerus back into the glenoid fossa

Traction on the Abducted Arm—The wrist of the anæsthetised patient is grasped as above The surgeon places his foot against the side of the chest

and scapula, and then exerts traction on the humerus, which is abducted to 90 degrees Steady continuous tension is maintained for upwards of ten minutes. An assistant then pushes the head of the humerus into position The continuous traction overcomes the muscular spasm and allows the dislocation to be reduced There is some danger of damage to the axillary structures in this and the preceding method

After treatment

Radiant heat is prescribed for the pain in the first week The patient exercises the limb from the beginning using especially the overhead pulleys (Fig 128) He is encouraged to place his hand behind the head and back to assist rotation

Heavy work may be resumed at the end of six weeks

Complications

1 *Fractured Surgical Neck*

2 *Injury to the Axillary Nerve*.—This is treated by supporting the limb on an abduction splint, combined with a course of electrical treatment for the deltoid muscle

3 *Fractured Greater Tuberosity*.—This is common and no special treatment is necessary The patient is encouraged to move the limb as in simple dislocations

4 *Tears of the Supraspinatus Tendon*.—Pain is not in the shoulder joint, but is referred to the insertion of or half way down, the deltoid There is a tender spot over the point of the shoulder The patient is able to abduct the arm voluntarily to about 30 degrees. Passive abduction to 90 degrees is possible but cannot be maintained actively The tenderness is increased and the patient winces as the arm is moved from 90 degrees to 100 degrees This condition is treated by immobilising the limb on an abduction splint until active abduction is present, but suture is occasionally necessary

5 *The Dislocation may be Compound.*

The Elbow Joint

Displacement is commonly backwards and laterally

The diagnosis is usually obvious, but should be confirmed by X rays, in case of medico-legal complications

Treatment

(*a*) The patient is anæsthetised on a low table The affected arm is abducted to a right angle The surgeon places his foot on a chair grasps the wrist with one hand, and the arm with the other and flexes the elbow round his knee. Lateral displacement is usually corrected at the same time by pressure on the head of the radius.

(*b*) The elbow is hyperextended and then flexed Both methods are effective. By hyperextension however, the damaged structures on the front of the elbow joint are further traumatised

The elbow is immobilised in plaster for a fortnight. When the plaster has been removed the patient is encouraged to move the joint actively Massage and passive movements are forbidden Quiet pastimes such as playing darts or bowls, are encouraged

Patients are able to return to heavy work at the end of two months.

Complications

1 *Myositis ossificans traumatica*, or new bone formation in the brachialis close to its insertion This is best treated by immobilisation in plaster Passive movements and massage are contraindicated as is early operative interference

2 *Ossification in the ligaments* and stiffness are treated as above Manipulation should not be attempted for six months

3 *Displacement of the medial epicondyle and ulnar nerve into the joint.* This is a fairly common occurrence The medial epicondyle can be replaced by manipulation Operative interference may be necessary to reduce the nerve

4 *Fracture of the coronoid process.* The elbow is immobilised in plaster for three weeks.

5 *Fracture of the olecranon* This occurs with forward dislocations

6 *Fracture of the head of the radius*

HEAD OF RADIUS

This is commonly displaced forwards when the upper third of the ulnar shaft is broken A hollow is palpable at the normal site of the radial head, and the dislocation is obvious in an X ray

Reduction —The counter traction band is placed over the upper arm, and strong longitudinal traction exerted on the fingers by an assistant. The head of the radius is pushed back into place and maintained by plaster Full flexion at the elbow joint, once the bone has been replaced will prevent recurrence, but must not interfere with the circulation Fixation is retained for a month

"*Pulled arm*" is a subluxation of the head of the radius, produced by pulling roughly a child s hand The child holds the forearm in the semi flexed and



FIG 197 —Note the gap in the antero posterior view and the backward displacement in the lateral position.

semi prone position Reduction is accomplished by full supination and flexion No after treatment is necessary

Dislocation of the Wrist—This is very rare It is reduced by traction Exercises are begun at the end of a week

Dislocation of the Distal Radio-ulnar Joint (Fig 107)—This is reduced simply by supinating fully the

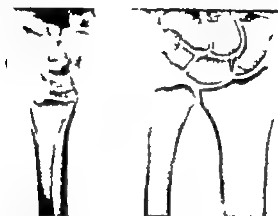


Fig 108.—Dislocation reduced by author's method of full supination.

forearm (Fig 108) Reduction is maintained in this position, with the elbow at a right angle for two months Even old-standing cases can be cured by this method



Fig 109—Plaster applied holding wrist in full supination

The Semilunar

The bone is rotated on a transverse axis so that the distal articular surface faces forwards or even upwards.



Fig 200—Anterior dislocation of the semilunar Note the position of the os magnum behind the semilunar

The patient may complain of tingling along the distribution of the median nerve Movements are painful Pressure over the median nerve on the front of the wrist is uncomfortable An X ray is essential (Fig 200)

Preliminary manual traction for ten minutes is always attempted This is difficult to maintain The following manœuvre is helpful Elastoplast is wrapped round the thumb and the fingers to prevent slipping A counter traction band is placed round the arm above the elbow A pad of wool is fixed round the wrist. The operator grasps the fingers and thumb and pulls steadily in the supinated position While this is maintained an assistant ties a loose knot with a domette bandage over the wool pad The long ends of this bandage are tied round the operator's buttocks as a sling (Fig 201) By this means tension can be alternated with manual traction The pronated position is desirable and the manœuvre is best carried out under X ray control When the shortening is seen to be overcome, gentle backward pressure on the semilunar may reduce the dislocation If this fails the wrist

In a certain number of cases all attempts fail, and subcutaneous division of the glenoid ligament or open operation is indicated

Other metacarpo-phalangeal dislocations require treatment along the same lines.

PHALANGES

Reduction of these dislocations is usually readily performed by traction in the hyperextended position, followed by flexion The finger is fixed in semi flexion by narrow strips of strapping for a week.

HIP JOINT

Dislocation is rare. The head of the bone may pass posteriorly or anteriorly In posterior displacement, when the obturator internus tendon remains intact, the head is prevented from travelling upwards If the tendon ruptures the head lies on the dorsum ilii In anterior displacement the head of the femur comes to lie on the horizontal ramus of the pubis or on the obturator externus muscle These four positions are classified as sciatic, dorsal pubic, and obturator

In posterior dislocations the limb assumes a position of flexion adduction and internal rotation The injured limb lies partly across the opposite thigh

The position of the limb in anterior dislocations is one of abduction and external rotation Shortening is most marked in the pubic and dorsal varieties It is replaced by lengthening in the obturator type

Treatment

The patient is anæsthetised lying on a mattress on the floor The knee and hip are flexed to a right angle The elbow is hooked under the knee and an attempt made to lift the patient off the floor while an assistant steadies the pelvis Traction is maintained and the thigh fully flexed In posterior dislocations

the thigh is then externally circumducted and straightened In anterior dislocations a similar manœuvre is performed, but the thigh is internally circumducted

The patient is advised to rest in bed for three weeks, or if danger of myositis is feared, a plaster spica is applied for two months Active exercises are encouraged

Complications

(*a*) Fracture of the rim of the acetabulum may require further immobilisation

(*b*) Arthritic changes may develop

Knee Joint

Traumatic dislocation is rare, the diagnosis obvious, and reduction easily effected by traction and manipulation in flexion The main importance of the condition is the liability to injury of the vessels and nerves in the popliteal space. One or both crucial ligaments are usually torn A walking plaster is applied for two months Pathological dislocation can be reduced even when of long standing, by Russell traction

Derangements of the Knee Joint

Tears of the Internal Lateral Ligament

Diagnosis

There is a history of violent abduction followed by sudden pain on the inner side of the knee A tender spot is found on pressure over the attachments of the ligament to the femur or tibia Pain is increased by abducting the joint.

The X ray is usually negative, but may show a detached flake of bone at either attachment of the ligament, and a widened joint space in complete tears

Treatment

1 *Partial Tears* —A pad of adhesive felt is placed along the ligament, and is bandaged firmly with elastoplast, the knee being straight. Walking is allowed, and the bandage is removed at the end of a month. Full movements are then encouraged If the case is not seen for several weeks after the injury and a tender spot is located along the ligament a few cubic centimetres of 2 per cent. novocaine are injected into the painful area and the patient en couraged to move the joint. A course of diathermy is helpful If pain still persists, the knee is manipu lated

2 *Complete Tears* —The joint is immobilised in *semi flexion* by plaster of Paris for two months Weight bearing is allowed

Displaced Internal Semilunar Cartilage

Diagnosis

There is a history of external rotation of the leg and abduction with sudden sickening pain on the inner side of the joint The knee cannot be extended fully immediately after the accident, and an effusion into the joint develops Tenderness over the anterior horn of the cartilage can be elicited

Inability to obtain the last few degrees of extension with a springy resistance to full movement suggests a bucket handle tear In lesions of the posterior horn the clinical picture is not so clear

Treatment

1 If locking is present the patient should be anæsthetised and the knee fully flexed One hand grasps the ankle and holds the leg in full external rotation, the other is placed on the outer side of the knee, and the joint is forced into the position of abduction It is then extended fully while the

abduction and internal rotation are maintained. This is the recognised method of reducing such displacement. But, the manœuvre actually consists of putting the joint through all its movements until the knee can be extended fully. A tight figure-of-eight bandage is applied over wool. Movements are restricted for about a week but weight bearing is allowed. A course of radiant heat and massage to the knee, and faradism to the quadriceps, is prescribed for a fortnight. In doubtful cases an arthogram is helpful.

2. When the cartilage has been displaced more than once, operative removal is necessary.

Cysts of the External Cartilage

There is usually a history of injury. The patient complains of a swelling over the lateral aspect of the joint. Pain is variable. There is seldom a history of locking or effusion. Both knees are bent to right angles and observed from in front. A small swelling is noticed on the lateral aspect of the joint over the upper edge of the tibial condyle. It is tender to touch, and fluctuation may be elicited.

Operative removal of the cartilage and cyst is indicated.

CHAPTER XIII

ANÆSTHETICS

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Broadly speaking anæsthesia may be either general in which case the subject is completely unconscious and insensitive to pain or local in which sensation of pain is abolished from a localised area of the body

Selection of an anæsthetic for a minor surgical operation depends upon whether (a) the patient wishes to leave immediately afterwards and to continue his normal routine, (b) he can remain in bed for a period of twenty four hours or so following the operation (c) the operator has to work single handed Obviously in the latter case only a local anæsthetic is indicated In ambulant cases, either a local anæsthetic or an inhalation anæsthetic of short action with quick recovery can be used. When the patient is confined to bed local spinal or inhalation anæsthesia may be employed, but basal anæsthesia, i.e. with such drugs as the barbiturates or avertin is often a preferable addition a pleasant induction and a slow and peaceful return to consciousness being obtained.

Choice of Anæsthetic

In addition to the above general considerations, other factors must be taken into account These include (a) the safety and comfort of the patient, (b) the patient s age and physical condition, (c) the type and duration of the operation

(a) **Safety and Comfort of the Patient.**—The patient s safety is the primary consideration There is always an element of risk in rendering a person unconscious, therefore local anæsthesia is the safest method, excluding idiosyncrasy to the drug employed, which is rare and accidental intravenous injection a contingency which can be avoided with care In skilled hands and under completely aseptic conditions, spinal

anæsthesia presents few dangers. The majority of patients however prefer to be unconscious during an operation and for this purpose in suitable cases nitrous oxide suitably administered is practically devoid of risk. Ethyl chloride is safe provided its use is not unduly prolonged as also is divinyl ether. Diethyl ether which causes a general metabolic upset and acts as an irritant to the respiratory tract cannot be classed as safe but as it has been used by many anæsthetists for a long time with moderate freedom from after-effect it must therefore be included as a possible choice in cases requiring prolonged muscular relaxation. Chloroform is dangerous being the cause of the majority of anæsthetic deaths and has no place in minor surgery except where there is an explosion risk and local nitrous oxide trilene or basal anæsthetics are not available. Trilene is a safe and suitable anæsthetic for minor surgery but will not produce muscular relaxation. Basal anæsthesia is perfectly safe when administered with care in suitable cases but it is necessary that a competent person should watch the patient until consciousness returns which may be after several hours.

(b) **Age and Physical Condition.**—Local anæsthesia is best administered to patients of all ages when *in extremis*. The primary choice of open ether for minor surgery is made only in the case of infants who are easily and safely controlled by a small amount of this drug but who react badly to ethyl chloride or nitrous oxide. Children take ethyl chloride divinyl ether trilene or a mixture of oxygen and nitrous oxide very well but react badly to nitrous oxide alone. Adults are quite suitable subjects for nitrous oxide ethyl chloride trilene or divinyl ether but the aged do not take well to the first two although the nitrous oxide-oxygen mixture trilene or the ethers may readily be used.

Intravenous basal anæsthesia should be confined to adults for infants and children are not suitable subjects for intravenous injection but basal anæsthesia by rectal injection can be safely and easily produced in infants children and adults.

Ether and ethyl chloride are contraindicated in respiratory diseases and, in severe conditions such as acute bronchitis pneumonia or bronchiectasis either local or spinal anæsthesia must be employed. In less severe conditions nitrous oxide and oxygen trilene cyclopropane or basal anæsthesia may be used. In compensated cardiac disease ether nitrous oxide and

oxygen or basal anæsthesia may be employed In decompensated cardiac conditions local anæsthesia or cyclopropane are indicated Nitrous oxide basal spinal or local anæsthesia are best in diabetes but basal anæsthesia is contraindicated in liver or gross kidney disease although here nitrous oxide and oxygen local or spinal anæsthetics may be used Any method but spinal anæsthesia may be used for cerebral and spinal diseases

(c) **Type and Duration of Operations.**—Short operations such as the incision of an abscess reduction of minor fractures or dislocations or removal of a painful dressing require no more than the production of unconsciousness over a minimum period and nitrous oxide ethyl chloride trilene or divinyl ether may be used Prolonged operations such as dissections of cysts or lipomata minor amputations or wound suture are indications for nitrous oxide and oxygen trilene local or basal anæsthesia For manipulation of joints considerable muscular relaxation is required although the operation is of short duration and this indicates nitrous oxide and oxygen if the patient is a suitable subject otherwise sufficient ether to produce relaxation must be added to the gas or basal anæsthesia must be employed

Certain operations requiring prolonged anæsthesia with muscular relaxation may be classified as minor surgical procedures e g herniotomy appendicectomy and tonsillectomy For these local spinal (except for tonsillectomy) basal or inhalation anæsthesia may be used The modern tendency however is to use a combination of methods to suit the particular patient and operation The best choice for patients considered "bad surgical risks" is cyclopropane or local anæsthesia supplemented with nitrous oxide and oxygen Spinal anæsthesia supplemented with nitrous oxide and oxygen is ideal for a large muscular athlete but for nervous or alcoholic patients induction by basal anæsthesia supplemented with nitrous oxide and oxygen plus sufficient ether to produce relaxation is the best choice

PRE ANÆSTHETIC EXAMINATION

Before giving any anæsthetic, the administrator should (1) examine the condition of the patient's lungs heart, and peripheral circulation (2) test or have a report on the urine

for the presence of albumin or sugar (3) examine the mouth for dentures (which must be removed before general anæsthesia) and for loose teeth or crowns which must be avoided if a gag is subsequently to be used During this examination every effort should be made to gain the patient's confidence and to reassure him regarding the anæsthetic

PRE ANÆSTHETIC PREPARATION

For local and spinal anæsthesia no preparation of the patient is required but for general anæsthesia a mild aperient should be given on the day before operation and if possible the patient kept resting and on an easily digested diet No solid food may be taken for at least six hours before the anæsthetic but liquid such as soup or tea may be taken up to three hours before All patients except diabetics, should take sugar freely for a day or two before operation This is easily absorbed if taken in the form of barley sugar Diabetics should receive insulin in conjunction with glucose before operation

Ambulant patients who are to be given a short anæsthetic such as nitrous oxide ethyl chloride or divinyl ether do not require elaborate preparation but should be advised to starve for at least three hours before and immediately preceding the anæsthetic to empty the bladder remove any dentures and loosen any tight clothing

In cases of emergency when food has been taken recently the stomach should be washed out If this is not practicable, induction by means of an intravenous basal anæsthetic will render less likely the occurrence of vomiting during induction, with the concomitant risks of inhalation of vomited material

PRE MEDICATION

All anæsthetics except local and those of the single-dose type given to ambulant patients require some form of drug beforehand to assist the subsequent course It is advisable to ensure a good sleep on the night before the operation by prescribing a sedative irrespective of the method of anæsthesia.

When nitrous oxide and oxygen (with or without ether) or a spinal anæsthetic are about to be administered to adults a mixture of omnopon ⅓ gr and scopolamine 1/150 gr is given. This is hypodermically injected one hour before the operation and creates a drowsiness which allays apprehension

reduces salivary and bronchial secretions, and assists the production of relaxation. The hypnotic is reduced for the aged or severely prostrated patients and replaced by an injection of atropine $\frac{1}{100}$ gr to $\frac{1}{75}$ gr and omnopon $\frac{1}{6}$ gr to $\frac{1}{3}$ gr according to the patient's condition

Infants and children should be given thirty minutes before operation an injection of atropine $\frac{1}{200}$ gr to $\frac{1}{100}$ gr according to age Paraldehyde given rectally in 10 per cent. saline solution, in doses of 1 drachm per stone of body weight some sixty minutes beforehand is a safe pre-anæsthetic hypnotic for nervous children as also is pentothal (see later)

Children up to 14 years of age may be given Nembutal or Seconal by mouth one hour before operation, in doses of 0 6 gr per stone of body weight up to a maximum of 3 grs. It is given in capsules which are pricked with a needle beforehand to prevent delayed absorption or the capsules may be emptied and the powder mixed with orange juice or jam.

Intravenous basal anæsthetics do not require any pre-anæsthetic drug, although their action is facilitated by hypodermic injection of morphine $\frac{1}{4}$ gr (or omnopon $\frac{1}{3}$ gr) and atropine $\frac{1}{100}$ gr fifty minutes beforehand

After treatment

After short anæsthesia by nitrous oxide, ethyl chloride or divinyl ether the patient may leave the operating room as soon as consciousness returns. He is allowed to rest for a few minutes to regain his perceptions and stability after which he may resume his normal activities

After prolonged anæsthesia by nitrous oxide and oxygen, trilene ether chloroform or basal anæsthetic, rest in bed for at least twenty four hours is essential The period until consciousness returns must be carefully watched The journey from theatre to ward must be made speedily and with the patient well wrapped in warm blankets The bed must be warmed with hot water bottles (which must not touch the unconscious patient) or by an electric blanket. The foot of the bed is slightly raised, and the patient kept on his side or on his back with the head turned to the side to allow secretions or vomit to run out. Until the reflexes return the tongue must be kept forward to prevent obstruction to respiration. The administration of carbon dioxide and oxygen

will quicken the return to consciousness and injection of coramine picrotoxin or icoral will hasten the detoxication of basal anæsthetic. No food should be given for at least three hours but thirst may be relieved by sips of water. Vomiting before consciousness returns needs no treatment other than attention to the airway but persistent vomiting may be treated by a draught of sodium bicarbonate 1 drachm in a tumbler of hot water. If it still persists it may be treated by washing out the stomach with a weak solution of sodium bicarbonate or by the administration of glucose and saline per rectum.

After spinal anæsthesia to prevent the onset of headache the patient must be kept flat on his back for six to twelve hours with the foot of the bed raised.

TYPES OF ANÆSTHETICS

I INHALATION ANÆSTHETICS

(a) Nitrous Oxide—Pure nitrous oxide may be used to abolish consciousness lasting approximately for one minute. It has no unpleasant smell, and if given skilfully induces anæsthesia without discomfort. With a mixture of nitrous oxide and air anæsthesia without relaxation may be maintained for about five minutes; using a mixture of nitrous oxide and oxygen anæsthesia with moderate relaxation may be maintained indefinitely, the amount of relaxation obtained depending on the state of the patient and the skill of the administrator. Fortunately those patients for whom nitrous oxide and oxygen are especially indicated are often frail and consequently are easily controlled by this anæsthetic.

Nitrous Oxide and Air

Indications—Short minor operations not requiring muscular relaxation in comparatively healthy subjects.

Contraindications—In infants, the aged, or patients with myocarditis or decompensated cardiac lesions,

oxygen must be given with nitrous oxide from the beginning of the administration

Apparatus —Only a simple apparatus is required (Fig 203) The cylinders must not be used alternatively, but one is kept in use until it is empty and then a change is made to the full one The stopcock contains valves A and B With A and B open the

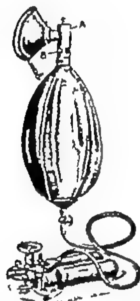


Fig 203 —N_2O apparatus.



Fig 204 Dental prop

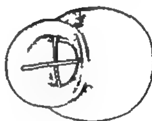


Fig 205 —Oral prop

patient breathes to and from the air with A and B closed, the patient breathes into and out of the bag with A open and B closed the patient inhales from the bag and exhales to the air

Administration —It is best to use a face piece with a pneumatic edge which should be partly distended to ensure an accurate fit In bearded patients the hair on the face should be moistened with water A

patent airway may be ensured by placing a dental prop (Fig 204) between the teeth or a mouth prop (Fig 205) between edentulous gums

Keeping valves A and B open the bag is partly filled with gas B is then closed, and the face piece gradually approximated to the patient's face, so that the first few breaths are taken without a feeling of pressure The face piece is then applied to the bridge of the nose and the chin with gentle downward pressure After half a dozen breaths A is partly closed so that part of the patient's expirations pass into the bag and are rebreathed On no account is the bag allowed to distend with gas until the patient becomes unconscious otherwise he will feel that he is being suffocated, but a steady flow is maintained by use of the foot key avoiding sudden gusts into the bag

As the administration progresses the breathing, which is irregular at first, increases in rate and depth and becomes regular the eyelids flicker and the eyes move about Anæsthesia is announced by typical stertorous breathing the eyes becoming fixed and expressionless The sense of hearing may not be abolished so absolute silence should be kept As the patient absorbs the gas into his blood the skin and mucous membranes become cyanosed but the colour is no indication of anæsthesia, as the amount of cyanosis varies with the individual

Overdose —If the administration is continued without the addition of air after the breathing becomes stertorous asphyxia supervenes The skin and mucous membranes become a deeper blue and eventually black jactitating convulsions occur the breathing becomes shallow and jerky and finally ceases Providing dilatation of the heart does not occur prompt artificial respiration or the administration of oxygen under pressure will revive the patient

If the face piece has to be removed to make way for

the surgeon, the administration must be stopped before jactitations occur as these will slow his performance and once partial asphyxia has set in the available period of anaesthesia is considerably reduced With experience the anaesthesia may be slightly prolonged by allowing it to proceed to the appearance of the first jactitation then admitting air for a breath or two, then more gas By this means, the patient is, so to speak, charged up with the maximum amount of gas For operations away from the area covered by the face piece anaesthesia may be prolonged for about five minutes by the judicious mixture of air (one or two breaths of air to three or four breaths of gas according to the patient's requirements) After five minutes, the anoxaemia produced is harmful.

Dental Gas —For dental extractions, nitrous oxide and air should be used by the nasal route always, even for a single extraction, for the tooth may break, and searching for a stump in a bleeding cavity with a struggling patient returning to consciousness can be a difficult and trying operation

Apparatus —The same simple apparatus as above may be used, substituting a nasal inhaler for the face piece There are various makes all fitted with an expiratory valve Thus the stopcock may be discarded or if used kept with valves A and B closed expirations to the air being controlled by the valve on the nose piece Karn s nasal inhaler (Fig 206)

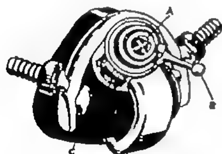


Fig 206.—Karn s nasal inhaler

has a lever for admitting air into the nose piece with other models air is admitted by lifting the inhaler off the nose or by opening valve B on the stopcock.

Some models have also a junction with a lead to a mouthpiece which can be used in inducing a patient who finds it difficult to breathe through the nose

Administration.—Before starting the patient should be impressed with the importance of breathing in and out through the nose, and he should be encouraged to this effect throughout the induction. A dental prop is inserted and the flow of gas into the bag controlled as before (p 372) The nose piece is applied, an accurate fit being maintained by holding it steady with the finger and thumb of one hand If the patient breathes through his mouth the mouthpiece is used or failing that the mouth is covered with the other hand When unconsciousness occurs, the bag is distended with gas and kept so throughout the administration As before, a judicious mixture with air will maintain anæsthesia without asphyxia, but if the patient breathes through his mouth as well as through his nose he will obtain too much air This is counteracted by keeping a heavy pressure on the bag with the knee, and by placing a marine sponge or gauze pack in the mouth The sponge or pack will also serve to prevent the entry to the larynx or oesophagus of any teeth which slip out of the forceps Throughout the administration the anæsthetist should stand behind the chair and strive to keep the patient in view, keeping his hands and body out of the dentist's way steadying the patient's head and preventing the nose piece from becoming dislodged holding the jaw up if it becomes depressed by the manipulations lest obstruction to breathing result Finally, a gag is kept ready and used when the dentist wishes to extract teeth from the side already occupied by the dental prop

Anæsthesia for dental extractions may be maintained by nitrous oxide and oxygen provided that the machine used has some means of delivering the gases at increased pressure

Nitrous Oxide and Oxygen

Indications—Any prolonged operation not requiring profound muscular relaxation

Method of Action—By the addition of pure oxygen instead of air atmospheric nitrogen is excluded from the mixture, and nitrous-oxide anæsthesia may be maintained without producing anoxæmia The percentage of oxygen required varies from 8 to 15, according to the individual patient The muscular relaxation produced is only moderate, and except in cases of severe shock, toxæmia, or hæmorrhage will be insufficient for abdominal operations Owing to the production of slight suboxygenation, capillary bleeding is pronounced

The anæsthesia may be deepened in a varying number of ways as follows

(1) *Reduction of Oxygen Percentage*—Will cause muscular rigidity, and must not be prolonged to a state of severe anoxæmia.

(2) *Secondary Saturation*—Consists of giving pure nitrous oxide almost to a state of complete asphyxia, resuscitating with pure oxygen under pressure, then continuing with a gas-oxygen mixture Produces brief relaxation, but requires a special machine and considerable experience and must only be used in robust patients

(3) *Efficient pre anæsthetic hypnosis or induction by basal anæsthetic*

(4) *Increase of Pressure*—Assists the absorption of the gases, and is done by increasing the rate of flow of gas and reducing the opening of the expiratory valve Tends to increase the amount of bleeding

(5) *Addition of Ether Trilene (or Chloroform)*

(6) *Combination with Local or Spinal Anæsthesia.*

Apparatus—All machines conform to one of two types—the continuous flow or the intermittent flow Space does not permit more than a description of the principles involved in each type

Continuous Flow—Cylinders of nitrous oxide, oxygen and carbon dioxide are fitted with reducing valves which maintain an even flow. The valves are connected to flow meters. Each gas flows at a constant rate, irrespective of the patient's respirations, the flow being regulated by a tap either on the reducing valve or on the flow meter. The gases may be diverted through a chloroform or an ether bottle and then flow into a bag. From the bag wide bore tubing carries the gases to the face piece which is fitted with an adjustable expiratory valve (Fig 207)

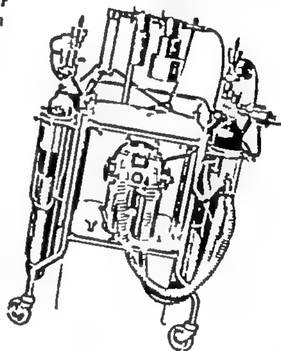


FIG 207—Boyle's continuous-flow machine. Coxeter's flow meters and B O C absorber

Intermittent Flow—By suitable valves, the cylinder pressures of nitrous oxide and oxygen are reduced and equalised. Each gas flows to its own bag which when full exerts pressure on levers which shut off the supply. From the respective bags the gases enter a mixing chamber in proportion to the setting of a mixing valve. The mixing chamber is closed by a weighted valve which opens only when the bags are allowed to overdistend or when the patient inhales. A supply of carbon dioxide an ether vaporiser and a re

breathing bag are included A tap on the oxygen inflow allows pure oxygen under pressure to be given to the patient (Fig 208)

Administration.—The induction is commenced with pure nitrous oxide, no rebreathing being allowed

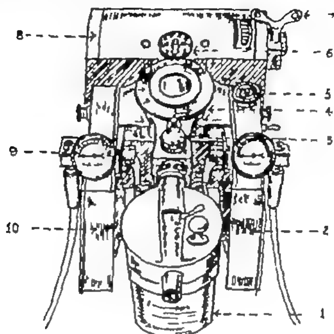


Fig 208 —McKesson Nargraf (Intermittent flow N_2O–O_2 apparatus)

1. Ether vaporiser.
2. Container for oxygen bag.
3. Control for adjusting pressure of mixed gases.
4. Mixing chamber with calibrated control.
5. Emergency oxygen button.
6. Dial for fine adjustment of oxygen percentage.
7. Spring adjustment of tension on rebreathing bellows.
8. Rebreathing bellows.
9. Reduced gas pressure gauge.
10. Container for nitrous oxide bag.

After half a dozen breaths the expiratory valve is adjusted so that the rebreathing bag fills without distension at each expiration Carbon dioxide may be added to assist the induction especially if ether is to be used At the first appearance of anoxæmia, oxygen is added gradually up to the requisite per

centage Clausen's harness (Fig 200) may be used to hold the face piece accurately and firmly in position

Closed-circuit Administration —This is the most modern method of administering nitrous oxide and oxygen The nitrogen in the patient's residual air is removed by allowing him to inspire from the machine and exhale to the air for about twenty breaths The expiratory valve is then closed and the rebreathing bag allowed to fill with nitrous oxide and oxygen in correct percentages The flow of fresh gases is now stopped, and the patient's respirations diverted through a filter containing soda lime The nitrous oxide remains unchanged and is rebreathed back and forth The oxygen lost by the patient's metabolism is made up by allowing a constant inflow of fresh gas, from 200 to 000 c c per minute The carbon dioxide produced by metabolism is absorbed by the soda lime



Fig 200 —Clausen's harness.

(*b*) **Ethyl Chloride.**—This drug is considered by many to be the ideal agent for induction as a preliminary to open-ether maintenance or as a complete anæsthetic for short operations not requiring muscular relaxation But many fatalities have occurred during its use and in no circumstances should it be used after the induction of unconsciousness as an overdose quickly produces paralysis of respiratory and cardiovascular centres When used to the limit of safety it will produce between sixty and ninety seconds' anæsthesia without relaxation

A highly volatile liquid it is supplied in glass phials fitted with spring caps In cold weather vaporisation will be facilitated by warming the phial in the hand

Indications.—Short minor operations in comparatively healthy subjects, not requiring muscular relaxation As a preliminary to open ether

Contraindications.—Infants, the aged, and patients with cardiac disease Operations where the explosion risk is present.

Administration by Open Method.—This requires no apparatus other than a wire mask, gauze, and gamgee tissue and is therefore very convenient

Technique.—The *mask is covered with six layers* of gauze Two pieces of gamgee tissue are taken and slits cut in the centres One piece of gamgee is placed on the patient's face on top of that the mask is placed and covered with the other piece of gamgee Modern ethyl chloride is flavoured with eau de Cologne, but is still very pungent, so the anæsthetic is commenced with a gentle spray on to the mask. This is followed by another few sprays, and then a continuous stream

Induction is rapid a matter of seconds, especially in children but may be accompanied by breath holding at first voluntary, later involuntary This is counteracted by the administration of carbon dioxide Anæsthesia is announced by stertorous breathing and fixed eyeball, with dilated pupil. Three or four stertorous breaths are allowed then the administration is stopped If maintenance is required an immediate change should be made to open ether the mask being saturated to ensure etherisation of the patient before the effect of the ethyl chloride has worn off *Chloroform must not be employed after ethyl chloride* as the risk of cardiac failure is greatly magnified by a combination of the two drugs

(*c*) **Divinyl Ether (Vinesthene)**.—This is an anæsthetic with quick action rapid recovery and freedom from unpleasant after-effects Its smell though powerful, has not the pungency of ethyl ether nor is it irritant to the respiratory tract It is believed

to have toxic effects on the liver after prolonged administration, but may be used with safety for short anæsthesia It will induce this with moderate relaxation in a time slightly longer than that taken by ethyl chloride, but with less likelihood of respiratory spasm If used as a single dose only, anæsthesia will last about ninety seconds The anæsthesia may be maintained by vaporising the drug with oxygen, or nitrous oxide and oxygen (see apparatus)

The drug is supplied in sealed ampoules of 3 c.c. a dose sufficient for induction, and in bottles of 25 and 75 c.c., but the larger quantities rapidly decompose on contact with air, and should not be used a second time

Indications —Short operations not requiring profound relaxation where quick induction and rapid recovery are desired

Contraindications —Operations lasting more than thirty minutes, patients suffering from liver disease presence of the explosion risk

Administration —May be performed by spraying on an open mask, but owing to the volatility of the drug the induction will be very wasteful and maintenance may be found difficult Some closed method is desirable, and various apparatuses have been designed (see below) A point of difference from other inhalation anæsthetics is the behaviour of the eyes The eyelids and eyeballs may move even when anæsthesia is present, and the pupils react irregularly with frequent changes in size


Fig. 210 —Goldman s inhaler

Apparatus —Goldman s (Fig 210) is suitable for single-dose administration It consists of a rebreathing bag and face-piece, with a vaporising chamber between them The chamber contains a sponge on to which 3 c.c of

the drug are poured For maintenance, numerous vaporisers have been devised for attachment to a nitrous oxide-oxygen machine, but it is possible to administer the drug by vaporisation with oxygen or nitrous oxide and oxygen from the standard ether or chloroform bottle on the machine

(*d*) **Diethyl Ether (Ether)**—This is the easiest drug for administration by the occasional anæsthetist, for with it anæsthesia is easily maintained and overdosage difficult to procure Therein lies its safety But it is a respiratory irritant, and causes toxic effects, the most common symptoms of which are post-operative vomiting and pulmonary congestion The pulmonary complications are more liable to occur in adults because of the stronger concentration necessary to maintain anæsthesia

Indications—Operations in infants, operations in children or adults requiring profound and prolonged muscular relaxation when other means of producing relaxation are not available

Contraindications—Respiratory disease ; operations where the explosion risk is present

Administration.—The most satisfactory way of administering this drug is as a supplement to nitrous oxide and oxygen (see p 375), whereby just enough ether is vaporised by the mixture to obtain the relaxation required It may, however be given by

The Open drop Method—This is suitable for induction of infants or for maintenance in other subjects when induction has been performed by other means e g nitrous oxide and oxygen ethyl chloride, divinyl ether, or basal anæsthetic. A gauze mask between two layers of gamgee tissue is used, and the induction commenced by dropping ether on to the mask at the rate of 1 drop per second The mask is gradually lowered on to the patient's face and the rate of drop slowly increased until it is almost a continuous stream Induction will be hastened and made free from respira

tory spasm by the use of carbon dioxide The patient passes through stages of excitement, struggling and breath holding, the degrees depending on the individual and the concentration of vapour used Eventually, again depending on the individual patient and concentration of vapour, a stage of automatic regular breathing is reached with relaxed muscles and moderately dilated active pupil Thus is surgical anæsthesia, and it may be maintained by allowing ether to drop on the mask at a steady and constant rate The more robust the patient the faster the rate of drop required to maintain anæsthesia Sporadic douching of the mask is bad technique and will produce uneven results When necessary the concentration of vapour may be increased by wrapping a piece of blanket or towel around the mask.

Overdose—If the concentration of vapour is allowed to become too strong for the particular patient he will gradually pass into the stage of overdosage This is characterised by very shallow breathing becoming sighing and eventually ceasing The pupil is now widely dilated and inactive to light, with absent corneal light reflex. The corneal reflex to touch is also absent, but must not be tested for the eye is easily damaged under anæsthesia Cessation of respiration if untreated, is followed in a few minutes by cessation of the circulation

(*e*) **Chloroform.**—This drug is the most toxic of all anæsthetics and care must be taken in its use both as regards the choice of case and the mode of administration.

Indications—Operations where the explosion risk is present and other non-explosive anæsthetics are not available

Contraindications—Infants the aged patients with disease of heart or liver nephritis diabetes anæmia, shock, cerebral or spinal disease, following the use of ethyl chloride divinyl ether or basal

anæsthetic when adrenalin is to be injected into the tissues, as in conjunction with local anæsthetic or in nasal operations

Administration.—The most satisfactory way of administering this drug is as a supplement to nitrous oxide and oxygen whereby just enough chloroform is vaporised by the mixture to achieve the desired result It may however be given by dropping on to an open mask, provided that oxygen is given at the same time, or a generous dilution with air is allowed by keeping the mask away from the patient's face During induction with pure chloroform, cardiac failure is liable to occur if there is marked struggling or if the operation is started before anæsthesia is complete, therefore induction by this means should not be attempted As a preliminary to open chloroform, nitrous oxide and oxygen open ether, or open C2E8 (2 parts chloroform to 8 parts ether) may be used For induction with C2E8 and maintenance with open chloroform a mask covered with lint is used The eyes and face are protected with gamgee and the mask is held about an inch from the face the drug being dropped on at a rate sufficient to keep the surface of the lint moist without soaking it Respirations will be quiet regular, and automatic, with relaxed muscles and contracted pupils Chloroform anæsthesia may also be maintained by vaporisation with air or oxygen, the most commonly used apparatus for this being the Junker Bottle (Fig 211) or the Shipway (Fig 212)

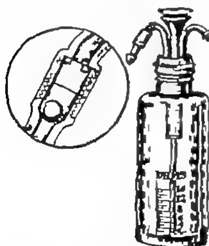


Fig 211 —Junker Bottle

Overdose.—The symptoms of this condition are the same as with ether, except that they occur with less warning, and cardiac failure occurs simultaneously with or immediately following respiratory failure.

(*f*) **Cyclopropane** (C_3H_6).—This is an inflammable gas, an isomer of propylene, having an anæsthetic

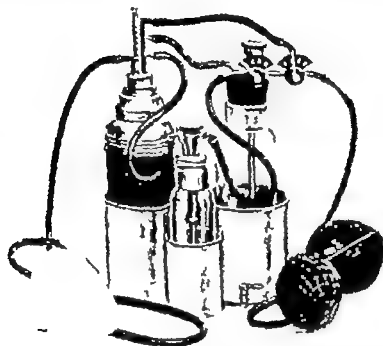


FIG. 212.—Shipway's apparatus.

potency greater than nitrous oxide but slightly less than ether. It has a low toxicity in anæsthetic concentration, being administered with a high percentage of oxygen. It is non-irritant to the respiratory tract and has a depressant effect on respiration; therefore lighter premedication should be used than with other anæsthetics. Recovery is rapid and free from severe vomiting although nausea may be present in some cases. The blood pressure is raised and there is an increase in the vascular ooze from cut tissues.

Indications.—Operations in patients of all ages

when relaxation greater than that produced by nitrous oxide is required Specially indicated in the elderly and patients with respiratory disease decompensated cardiac disease anæmia, or shock

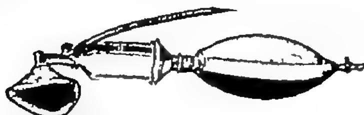


FIG 213 —Waters single phase CO_2 absorber

Contraindications —Operations where the explosion risk is present operations marred by vascular oozing such as neuro-surgery patients with jaundice

Apparatus —A CO_2 absorption apparatus is required There are two types

(*a*) *Single phase or " to and fro "* (Fig 213) —This consists of face piece soda lime canister and rebreathing bag The face-piece connection is linked by rubber pressure tubing to flow meters for cyclopropane and oxygen the gases thus flowing direct to the patient Complete rebreathing takes place through the canister of soda lime into the rebreathing bag

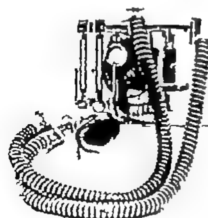


FIG 214 —Brompton circle-type CO_2 absorber

(*b*) *Two-phase or circle type* (Fig 214) —This consists of flow meters soda lime canister and *rebreathing bag linked to the face piece by twin hoses* of wide bore non kinkable rubber The gases flow

through one hose to the face piece, and the patient's exhalations flow along the other through the soda lime and into the rebreathing bag. The direction of flow is controlled by two one way valves on the apparatus.

Administration.—The circuit is filled with oxygen, and the flow of oxygen necessary to make up that lost by metabolism is established between 200 and 600 c.c. per minute. Cyclopropane is now added at the rate of 500 c.c. per minute until anæsthesia is established. Cyclopropane is now turned off. During the maintenance of anæsthesia constant additions of cyclopropane are required to compensate for gas lost by leaks in the apparatus or at the junction of mask and face or by diffusion through the rubber bag and tubing. These additions are made 50 to 100 c.c. per minute at a time or by a continuous trickle flow of 25 c.c. per minute. At the end of operation, the circuit is opened and the patient allowed to inhale pure oxygen and a little carbon dioxide so that as much cyclopropane as possible is excreted before leaving the theatre.

Dangers.—Overdose quickly produces respiratory and cardio-vascular failure which respond to the administration of oxygen under pressure provided that it is given soon enough. The great danger lies in the failure of the inexperienced to recognise the signs of overdose in time. Owing to the absence of irritation to the respiratory tract and to the absorption of carbon dioxide the breathing is quiet at all times. The patient will pass rapidly and smoothly from light to deep anæsthesia without exhibiting the usual signs. The pulse must be studied carefully all the time. Any variation from normal such as bradycardia, tachycardia, or arrhythmia indicates approaching overdose. The concentration of cyclopropane must then be reduced by the addition of oxygen to the mixture.

(*g*) **Trichlorethylene** (Trilene)—This is a liquid non inflammable and non-explosive in mixtures with air or oxygen It is not volatile enough to vaporise on an open mask, but must be vaporised from a container by means of air or oxygen Its odour is similar to chloroform, therefore it is mixed with waxoline blue to avoid confusion It produces analgesia fairly rapidly, but is slow in inducing anæsthesia and does not produce marked muscular relaxation It is non irritant to the respiratory tract but attempts to produce muscular relaxation by increasing the vapour concentration result in hyperpnœa and cardiac arrhythmia Recovery is rapid after short administrations, but delayed after prolonged ones

Indications—Procedures in patients of any age or condition requiring analgesia only such as removal of painful dressings or packs, wedging or removal of plasters the early stages of labour operations of any length which do not require muscular relaxation for induction before using ether or as a supplement to intravenous barbiturate or nitrous oxide and oxygen the presence of the explosion risk.

Contraindications—Trilene *must not be used* by CO_2 absorption technique as in combination with soda lime dichloracetylene is formed Inhalation of this vapour produces permanent cranial nerve palsies

Apparatus—The liquid may be vaporised by oxygen or nitrous oxide and oxygen from the chloro form bottle' on a standard nitrous oxide and oxygen apparatus Marrett s Trilene Vaporiser (Fig 215) may be used This consists of a bottle containing a wide bore tube and wick, which offer little resistance to respiration On top of the bottle is a rotating drum mechanism similar to that on Boyle s apparatus Air enters through an inspiratory valve at the open end of the apparatus or oxygen may be admitted through a tap The rotating drum allows any amount

of air or oxygen to be diverted through the bottle The vapour then passes through a short length of wide bore non kinkable rubber hose to the face piece, which is equipped with an expiratory valve

Administration—During the induction the vapour concentration must be increased very gradually, otherwise hyperpnœa and arrhythmia will result Once anæsthesia is established the vapour concentration can be reduced to the minimum and kept there throughout the maintenance If the administration is prolonged towards the end of operation the anæsthetic should be stopped as after prolonged use excretion of this drug is slow If muscular relaxation is required ether should be used in preference to an attempt to produce it with trilene which will only result in hyperpnœa

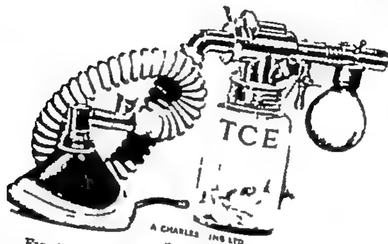


FIG 215—Marrett s trilene single bottle unit

PHARYNGEAL INSUFFLATION

For operations on the head neck, face nose or mouth anæsthesia may be maintained by insufflating

ether, trilene, or chloroform vapour into the nasal or oral pharynx. As a vaporising medium, air may be used from a hand or foot bellows, but better results will be obtained by employing oxygen, or nitrous oxide and oxygen A simple vaporising bottle of the Junker or Shipway type may be used, or a continuous flow nitrous-oxide-oxygen machine if it is available The anæsthetic vapour may be blown into the nose or mouth through a metal or rubber tube, or into the pharynx through an airway

Endotracheal Anæsthesia

Advantages—A perfect airway is maintained giving complete freedom from respiratory obstruction Relaxation may be obtained at a lighter level of anæsthesia, and the respiratory excursion of the diaphragm considerably reduced Any operative position may be assumed without interference with the airway or with the administration The surgeon has free access to the head face nose, mouth, or pharynx, and the anæsthetist and his apparatus are away from the field of operation By suitable packing operations in the nose, mouth or pharynx can be performed without the risk of the patient inhaling blood or other foreign matter

Disadvantages—The time of the anæsthetic may be increased in performing the intubation of the trachea, and post-operative sore throat may result from trauma. Both these factors are dependent on the skill and care of the administrator

Indications—Operations on the head neck, face nose, mouth and pharynx operations requiring awkward posture of the patient long operations requiring quiet respirations

Contraindications—Operations on the eye which would be marred by post-operative coughing

Technique and Apparatus—In modern practice

insufflation of the anæsthetic under pressure through a narrow catheter has been supplanted by the inhalation method, whereby the patient breathes in and out through a wide bore catheter, either on a closed circuit with carbon-dioxide absorption, or expiring to the air through a valve The trachea is intubated through the nose or mouth according to the site of operation or the preference of the administrator Magill's catheters are the most commonly used (Fig 216) They are



FIG 216 —Magill's endotracheal catheter

made of rubber, specially moulded on a slight curve, with an obliquely cut end to facilitate passage between the vocal cords There are two qualities—hard for oral use to prevent kinking over the dorsum of the tongue soft for nasal use to prevent trauma. They vary in bore and are numbered from 00 to 10 The average adult male nose takes number 8 or 9 female 7 or 8, and so on down the scale according to the size of patient, to 0 or 00 for infants For oral intubation a slightly larger bore can be used than for nasal. The length required can be gauged by remembering that the distance from nostril to larynx equals one and a half times the distance from nostril to the lobe of the ear Too short a tube will not enter the trachea too long a tube may enter a bronchus or press on the bifurcation of the trachea, causing trauma and kinking the tube When in position the tube is connected to the expiratory valve of a gas-oxygen machine by a special angle piece and adapter (Fig 217) The angle pieces are made in varying sizes to match the catheters, which latter tend to become soft and stretched with age Thus the connection may become detached during the operation, and the cathete-

disappear down a bronchus This can be avoided by tying tape or adhesive plaster around the end of the catheter, or by inserting a safety pin through the end For operations in the nose or mouth the pharynx is packed either with small, soft marine sponges attached to tapes for withdrawal or with sterile gauze bandage soaked in paraffin or vaseline *Dry gauze must never be used,* as it will inevitably cause sore throat



FIG 217—Magill's angle-piece and adapter attached to expiratory valve.

Nasal Intubation—A preliminary spraying of the nose with 20 per cent cocaine will reduce congested turbinates and diminish the risk of bleeding The catheter is lubricated with sterile vaseline or catheter lubricant, and the side of the nose which is less obstructed is chosen Intubation is best performed under light anæsthesia with nitrous-oxide-oxygen-ether sequence ethyl chloride, trilene or divinyl ether and the addition of carbon dioxide just before passing the catheter will facilitate matters The level of anæsthesia to aim at is just as the cough reflex disappears a lighter level will cause laryngeal spasm when the tube enters the naso-pharynx a deeper level will allow the tube to enter the œsophagus When the required level of anæsthesia is reached the face piece is removed and the tube passed swiftly but gently into the nostril with the point kept well forward so that it passes along the top of the palate and not into the superior meatus of the nose If any obstruction such as a nasal spine is felt, the tube is eased gently past If this is not possible, it must not be forced but removed and inserted on the other side Thus will

trauma and bleeding be avoided On entering the naso pharynx, breath sounds are heard through the tube If these are followed with the point of the tube kept in the mid line and the patient's head in natural relation to his body the trachea will be intubated If the cords go into spasm, the tube must not be forced through, but should be withdrawn into the naso pharynx while the anæsthesia is deepened If the œsophagus is intubated sucking sounds will be heard which can be easily differentiated from breath sounds If breath sounds are heard they may be coming through the other nostril while the tube lies in the œsophagus An accurate diagnosis of the position of the tube can be made by closing the unoccupied nostril with a finger and listening carefully at the end of the tube Any deviation from the mid line, due either to nasal deformity or to lack of touch on the administrator's part may take the point of the tube into the pyriform fossa causing a visible bulge in the neck If this happens, a twist of the end of the tube in the fingers will bring the point back to the mid line If the œsophagus is entered in spite of lack of spasm and a mid line course hyperextension of the head may enable the trachea to be intubated In other cases with a tube which is curved too acutely flexion of the head may be necessary All the above manœuvres must take place in a matter of seconds otherwise the anæsthesia will become too light for intubation Successful blind intubation comes consistently only after much practice if it fails after one or two attempts the anæsthesia must be deepened and a laryngoscope passed The end of the tube may then be picked up with forceps in the pharynx and gently inserted into the trachea by direct vision

Oral Intubation.—This is best performed under deep anæsthesia, so that the jaw is relaxed and the pharyngeal and cough reflexes have disappeared The anæsthesia must be so deep that it is unnecessary

to force the mouth open or hold it so with a gag. The patient's head is kept in the natural position of extension avoiding hyperextension such as is produced by a sand bag under the shoulders The laryngoscope is held in the left hand, and the patient's mouth is opened with the right hand The blade of the instrument is passed gently over the dorsum of the tongue, the epiglottis is identified, and the tip of the blade passed behind it. Then by a lifting movement (as if to raise the patient's head off the table) as *opposed to a levering movement, the cords will be* exposed. Levering of the blade must be avoided, as it may break the upper incisor teeth When the cords are exposed to view the tube is picked up in the right hand and passed between them while they are wide open A firm tube may be passed by hand a soft and flaccid one will require to be held in forceps

2 BASAL ANÆSTHETICS

Evipan Sodium (Cyclonal Hexobarbitone, Hexanostab, Narconumal)

A complex sodium salt of barbituric acid It is supplied in sealed *ampoules containing 0 5 gm* and 1 gm in powder These are dissolved respectively in 5 c c and 10 c.c distilled water from sealed ampoules immediately before use

Pentothal Sodium (Sodium Thiopentone)

A complex sodium salt of barbituric acid containing a sulphur molecule It is supplied in sealed ampoules containing 0 5 gm and 1 gm in powder These are dissolved respectively in 10 c.c. and 20 c.c. distilled water from sealed ampoules immediately before use

Action of Evipan and Pentothal.—When injected into the circulation these drugs act on the central nervous system in a matter of seconds causing the patient to pass from complete consciousness into un

consciousness without resistance Further injection causes the unconscious state to become one of anæsthesia with muscular relaxation but without loss of pharyngeal and laryngeal reflexes The action of the drugs also causes depression of the respiratory centre, and an overdose will cause complete inhibition of the respiratory centre followed by inhibition of the cardiovascular centre The drugs are rapidly detoxicated in the liver and excreted by the kidneys Pentothal, by reason of its sulphur molecule is detoxicated more rapidly than evipan

After-effects—With the cessation of surgical stimuli the sleep produced by these drugs lasts for a time varying from a few minutes to several hours So far, no means have been found of assessing in advance the time of recovery The return to consciousness may be accompanied by a period of excitement, but vomiting is rare and pulmonary complications extremely unlikely As with any barbiturate ocular palsies causing double vision may occur but these will be transient When consciousness is regained, a feeling of mild intoxication may persist for several hours and in rare cases for several days

Indications—Any operation short or prolonged where a swift and pleasant induction is desired, and a slow recovery is no objection

Contraindications—Severe toxæmia hepatic disease and the aged

Apparatus—All that is required is a 10-c.c. syringe and needles one of narrow bore for injection, one of wide bore for quick mixing of the solution For ease of injection a syringe with an eccentric nozzle and a needle with a short bevel to the point are recommended

Induction.—The solution is mixed and the skin of the ante-cubital fossa prepared with spirit or iodine If no vein is visible or palpable in the ante-cubital region one may be found in the forearm or on the dorsum of the hand In cases where a suitable ve

cannot be found, a hot fomentation applied twenty minutes before operation may succeed in producing one. An assistant places a tourniquet round the arm (taking care not to obliterate the arterial pulse) or squeezes the arm with a hand. The arm is held steady in extension by a sand bag under the elbow and an assistant's hand on the wrist. The patient is instructed to open and close his hand several times, so that the veins are made prominent. The skin and the vein are pierced with the needle, a little blood is aspirated into the syringe, the assistant loosens the tourniquet and the injection is commenced. Engaging the patient in conversation, 2 to 3 c.c. are *injected in thirty seconds, then a pause is made to* observe the effect. Normally the patient responds to questions for between thirty and sixty seconds from the commencement of the injection. Then he yawns, takes a few shallow breaths, becomes unconscious and ceases to breathe. This period of apnœa may last from one to one and a half minutes, but the colour and pulse remain normal. Safety lies in withholding the injection during the period of apnœa. When the breathing recommences the injection is continued at the rate of 1 c.c. per fifteen seconds (pausing if a further period of apnœa occurs) up to a maximum dose of 1 gm. evipan or 0.5 gm. pentothal. Abnormal reactions may occur as follows: (*a*) unconsciousness before thirty seconds have elapsed from the commencement, indicating poor resistance to the drug and necessitating moderation of the dose; (*b*) a conscious patient sixty seconds after the commencement, indicating either extravenous injection (which can be tested by aspiration), or a resistant patient necessitating further injection of 1 or 2 c.c. in fifteen seconds and a furth[illegible] and so on up the maximum dose.

The maximum dose [illegible] [illegible]thesia moderate relaxation for a [illegible] g from t[illegible]

twenty minutes relaxation being better with pento thal, but the effect lasting longer with evipan

Maintenance—(1) *Fractional Dosage*—This may be performed (*a*) by making a series of injections into the tubing of a continuous intravenous saline apparatus, (*b*) by making a series of injections by venepuncture (*c*) by using a syringe and three way tap

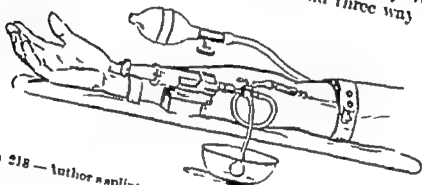


FIG 218—Author's splint with Luerlok syringe and three way tap

as illustrated (Fig 218) Throughout the maintenance the respirations should be closely observed Lundy's "cotton butterfly" is a useful aid in observing shallow respiration It consists of a thin piece of cotton wool shaped like a butterfly and fixed to the upper lip with adhesive strapping so that one wing is over the mouth and the other over the nose Increased rate and depth of respiration is a sign that anæsthesia is becoming light This will be followed by movements of the eyelids or limbs A further 1 or 2 c c are quickly injected which will immediately result in relaxation and control of the patient This procedure can be repeated for the duration of the operation For prolonged administration of pentothal 2½ per cent solution (i.e 1 gm in 40 c c distilled water) should be used instead of the usual 5 per cent By this means smaller doses of the drug will be used

(2) *Continuous Dosage*—Anæsthesia with moderate relaxation can be maintained indefinitely by a continuous drip of pentothal in solution with normal saline, plasma, or blood The dose is 2 gms to the pint Glucose saline must not be used as a precipitate forms in this solution The rate of drip is varied according to the patient's reaction After doses exceeding 1 gm, 5 c c of coramine nikethamide or phrenazol or 2 c c of picrotoxin should be given intravenously at the end of operation to stimulate respiration and help detoxicate the barbiturate

Rectal Administration—Evipan or pentothal can be given rectally in doses of 1 gm per 50 pounds of body weight The drug is made up in 5 per cent solution Ordinary tap water may be used The solution is given twenty to thirty minutes before operation, producing basal narcosis without anæsthesia Anæsthesia may be produced by nitrous oxide and oxygen cyclopropane trilene or ether The narcosis is useful before spinal or local anæsthesia in nervous patients In infants and children minor procedures requiring analgesia only may be performed, *e g removal of sutures following operation* for cleft lip

Complications—Overdose produces respiratory failure which will be followed by cardio vascular failure if untreated This may occur at any time during the administration and must be treated immediately by rhythmical inflation of the lungs with oxygen For this reason, intravenous barbiturate should never be given without the means of oxygen inflation at hand If the overdose is slight spontaneous respiration will *start after one or two inflations* If the overdose is severe artificial respiration may be required for a considerable time In that case, respiratory stimulants should be given intravenously e g 10 c c. of coramine or 8 c.c. of picrotoxin Lumbar puncture and drainage may also help as barbiturates are

present in cerebro spinal fluid before they are de-toxicated

Extravenous injection must be treated by application of fomentations otherwise local inflammatory reaction in the tissues may occur After doses exceeding 1½ gms, the patient's temperature may rise within a few hours This is only transitory and

ERRATUM

P 399 line 10

for 'scopolamine $\frac{1}{25}$ gr' *read* 'scopolamine $\frac{1}{150}$ gr'

and unco-operative patients under loca[illegible] anæsthesia The injection must be given slowly and carefully any undue respiratory depression being treated as described for overdose of barbiturate

Avertin

Tribrom-ethyl alcohol dissolved in amylene hydrate, 1 c.c equalling 1 gm This is administered by rectal injection, in 2½ per cent solution in distilled water the dose being 0 1 gm per kilogramme of body weight The solution must be made and kept at a temperature between 30° and 40° Centigrade, for below 30° it crystallises while above 40° it forms hydrobromic acid Hydrobromic acid is a rectal irritant, and its presence is demonstrated by the Congo Red test Two or three drops of Congo Red to 5 c.c Avertin solution red colour denoting a normal solution, blue colour denoting the presence of hydrobromic acid

Indications —Operations where it is desired to send the patient to sleep comfortably and easily in bed and no contraindications arise As an assistant to the course of nitrous-oxide-oxygen for prolonged operations requiring relaxation with minimum of bleeding where other means of relaxing muscles are contraindicated or not available

Contraindications—Disease of liver or kidneys colitis before anæsthesia with chloroform operations in the upper abdomen

Administration—The solution being mixed, the patient is turned on to the left side with a pillow under the buttocks, and the drug administered into the rectum through a narrow rubber catheter Between ten and fifteen minutes should be taken over the injection The patient should be fully under the influence of the drug in thirty minutes but any undue susceptibility will be shown by unconsciousness occurring within ten or fifteen minutes In that case *the dose should be modified to three-quarters* Atropine $\frac{1}{100}$ gr is given hypodermically at the commencement of the injection

8 LOCAL ANÆSTHESIA

Indications—Minor surgery when the operator has to work without an anæsthetist or when the patient desires to return to work immediately Operations on aged or moribund patients or those *with decompensated cardiac disease acute pulmonary* disease renal disease or diabetes severe shock or hæmorrhage To make painless certain procedures frequently carried out without anæsthesia, such as lumbar or pleural puncture

Contraindications—Children and highly nervous adults The presence of sepsis at or near the site of injection

Drugs—Two drugs are in common use cocaine and novocaine, the choice depending on the method of application They are administered in solution with normal saline, the percentage varying with the method of application Adrenalin is added (5 drops of a 1 in 1 000 solution to the ounce of anæsthetic) to assist hæmostasis and prolong the anæsthesia by delaying absorption

Methods of Application

Instillation—For anæsthesia of the conjunctival sac, a few drops of 4 per cent cocaine solution are dropped into the sac and the instillation repeated in five minutes

Spraying or Painting—For anæsthesia of the buccal pharyngeal or laryngeal mucosa, 5 per cent cocaine solution is used, and the whole area thoroughly sprayed, or painted with a cotton wool swab soaked in the solution, the procedure being repeated after an interval of ten minutes

Packing—For anæsthesia of the nasal mucosa, spraying or painting with 5 per cent cocaine solution may be used but the best results are obtained by packing each side of the nose with ribbon gauze soaked in the solution at least half an hour before operation

Infiltration and Regional Block—These methods may be used for anæsthesia of any part of the body, either superficial or deep excepting the mucous membranes Anæsthesia may be induced by either method or by a combination of both as follows (*a*) infiltration of the tissues at and around the site of operation with 0 5 per cent novocaine solution, (*b*) injection of 1 per cent or 2 per cent novocaine solution into and around the trunks of the nerves supplying the site of operation

Technique—The novocaine solution is sterilised by boiling The syringe and needles with which the injection is made are sterilised by boiling in distilled water or soaking in spirit as the alkali present in tap water will destroy the potency of the anæsthetic solution After the injection has been made a few minutes should be allowed for the anæsthetic to act

Examples of local anæsthesia commonly required in minor surgery

1 *Removal of Superficial Tumour or Cyst*—Four

or more points are taken around the periphery of the tumour and well away from it and at each point an intradermal wheal is raised with 0 5 per cent solution This is done by inserting a short fine-bore needle through the epidermis only, and injecting about 0 5 c.c under pressure Through the intradermal wheals a long needle is inserted and the deep tissues surrounding and underneath the tumour are infiltrated Then the subcutaneous tissues surrounding the tumour are infiltrated so that it is completely enclosed by a barrier of local anæsthetic Finally, an intradermal wheal is raised along the line of incision

2 *Tracheotomy*—Using 0 5 per cent solution, an intradermal wheal is raised along the proposed line of incision Through this wheal, the subcutaneous and deep tissues down to the trachea are infiltrated on each side of the incision

3 *Brachial Plexus Block*.—For operations on the superior extremity

Supraclavicular Method—An intradermal wheal is raised 1 cm above the mid point of the clavicle, just lateral to the point of palpation of the subclavian artery With the index finger the artery is retracted downwards and medially a long, unattached needle is inserted through the wheal and directed posteriorly downwards and medially towards the first rib At a depth of 2 to 3 cm the plexus is reached indicated by the patient feeling a tingling sensation in the hand At this point the syringe is attached and 10 c.c. of 2 per cent solution injected The needle is then slightly withdrawn and reintroduced in a more posterior direction towards the transverse process of the 6th cervical vertebra, where 5 c.c. of solution are injected Finally the needle is partially withdrawn and reintroduced downwards towards the lateral border of the first rib, where 5 c c. of solution are injected

4 Injection around and into nerve trunks of the superior extremity for operations on forearm or hand

At the point of surface marking of the nerve, an intradermal wheal is raised with 0 5 per cent solution Through this point 5 c.c of 1 per cent solution are injected around the nerve

Ulnar Nerve—Injection is made either in the groove between the medial epicondyle of the humerus and the olecranon or on the medial side of the wrist just lateral to the tendon of flexor carpi ulnaris at a depth of half an inch

Median Nerve—Is injected through an intradermal wheal at the wrist, where it lies immediately deep to the tendon of palmaris longus

Radial Nerve—May be blocked in the arm by a deep injection against the bone at the junction of upper and middle thirds of a line between the insertion of deltoid and the lateral epicondyle of humerus The terminal superficial branch may be blocked by an injection at the junction of middle and lower thirds of the forearm on the lateral and posterior aspect of the tendon of brachio-radialis

5 Injection points for nerves of the inferior extremity

Femoral Nerve—Half an inch lateral to the mid point between the anterior superior iliac spine and the symphysis pubis just below the inguinal ligament

Sciatic Nerve—Midway between the ischial tuberosity and the greater trochanter when the thigh is rotated laterally, at the lower border of gluteus maximus at a depth of 2½ to 3 inches

Posterior Cutaneous Nerve—The same point as for the sciatic nerve

Lateral Cutaneous Nerve—One inch medial to and below the anterior superior spine of the ilium

Tibial Nerve—The middle of the popliteal space at a depth of ½ to ¾ inch

Common Peroneal Nerve.—On the posterior aspect of the head of the fibula

Saphenous Nerve.—Immediately below the medial condyle of the tibia in line with the medial border of the shaft

6 *Operation on Finger or Toe*.—Using 0 5 per cent solution intradermal and subcutaneous injections are made around the proximal end of the digit The needle is then passed into the web at each side of the digit, and 1 c c of solution injected thus blocking the digital nerves

7 *Rib Resection for Empyema*.—Four intradermal wheals are raised over the intercostal spaces above and below the chosen rib anterior and posterior to the site of resection Through the lower posterior wheal a needle is inserted and allowed to slide over the lower border of the rib to be resected, 10 c.c of 1 per cent solution then being injected This manœuvre is repeated through the upper posterior wheal at the lower border of the rib above the one to be resected Then through all four wheals a complete subcutaneous infiltration of the area is made with 0 5 per cent solution. Finally an intradermal wheal is raised with 0 5 per cent solution along the line of incision

8 *Reduction of Simple Fracture*.—Novocaine 2 per cent solution without adrenalin is used The fracture is accurately located by X ray, and an intradermal wheal raised over it Through this a long needle is inserted into the hæmatoma between the fragments The accurate position of the needle is confirmed by injecting a few c c. of solution and then aspirating Ease of injection and the aspiration of blood-stained fluid confirm the correct position Then between 20 and 50 c.c. of solution are injected, according to the nature of the fracture. After an interval of five minutes reduction is performed

Spinal Anæsthesia

This method consists of the production of a loss of sensation to pain in prescribed areas, by the intra thecal injection of local anæsthetic, the aim being to block the sensory nerve roots at certain levels. As the motor roots are also affected, the level of anæsthesia should never be permitted to rise higher than the 5th dorsal roots for above this level, embarrassment of the muscles of respiration will occur.

Indications.—Minor surgical procedures on the abdomen, perineum or lower extremities in patients suffering from or liable to suffer from respiratory disease, and in diabetics. Procedures requiring prolonged relaxation in muscular subjects who would otherwise require large amounts of inhalation anæsthetic.

Contraindications.—Patients with severe shock anæmia abnormally low or high blood pressure decompensated cardiac disease cerebral or spinal disease. Infection in the region of the proposed thecal puncture.

Apparatus.—The needle for lumbar puncture should be very thin with the bore not greater than 1 2 mm., 9 cm in length and the point cut with a short bevel not exceeding an angle of 45° (Fig. 219).

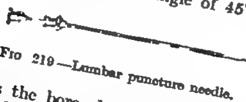


Fig. 219.—Lumbar puncture needle.

A stylet fills the bore during the puncture. Two syringes (all glass or Record) are required of 1 c c and 20 c c. capacity. The syringes and needles may be sterilised by boiling in distilled water or kept in spirit being rinsed in sterile distilled water before use.

Drugs.—A large variety of drugs is in use for spinal anæsthesia. This description will be confined to two

(a) Stovaine (Chaput's solution) contains stovaine 0 1 gm sodium chloride 0 1 gm, distilled water 1 c c and has a specific gravity higher than cerebro spinal fluid It is supplied in sealed ampoules of 1 c c

(b) Nupercaine solution 1 in 1 500 with 0 5 per cent saline which has a specific gravity lower than cerebro spinal fluid It is supplied in sealed ampoules of 20 c.c

After-effects

Respiratory embarrassment may occur from diffusion of the drug to too high a level and is treated similarly to the respiratory failure occurring from an overdose of general anæsthetic (p 411)

Severe fall in blood pressure is considered to be due to toxic absorption of the drug into the circulation It is most unlikely to occur with low spinal but with the higher blocks it may be minimised by the intra muscular injection of ephedrine 1 gr immediately following the spinal injection Should the systolic blood pressure fall at any time to less than 80 mm of Hg intravenous injection of ephedrine ½ gr will counteract this At the same time oxygen and carbon dioxide should be administered and, if neces sary cardiac stimulants such as coramine

Headache will be less likely after puncture with a fine needle and if the patient is kept flat on his back with the foot of the bed slightly raised for six to twelve hours after operation Should it occur and not yield to sedative treatment, the administration of hypertonic saline intravenously or magnesium sul phate [illegible] oz in [illegible] oz water per rectum, will relieve it

Paralysis of sphincters causing incontinence may occur but passes off in a day or two Ocular palsies may arise due it is thought to toxic absorption of the drug but disappear in a few days Permanent paralysis will occur only if direct trauma is caused to the spinal cord and thus spinal puncture should never

be made at a higher level than the space between 2nd and 3rd lumbar vertebræ.

Meningitis may follow if a completely aseptic technique is not adhered to

Administration

Technique of Lumbar Puncture and Injection — This may be performed either in the sitting or lateral position according to the method employed For the former, the patient sits on the table with his feet on a stool and his head and shoulders bent forward so that the back is arched For the latter the patient lies on his side with his knees drawn well up and his head and shoulders bent towards his chest care being taken that the shoulders are at right angles to the table otherwise the vertebral column will be rotated and puncture made difficult The skin of the back is prepared with spirit or iodine and a sterile towel stretched across between the highest points of the iliac crests crossing the vertebræ at the level of the 4th lumbar spine The appropriate interspinous space may thus be marked on the surface and over it an intradermal wheal is raised with 1 per cent novocaine solution Through this wheal the spinal needle is passed and is felt to be gripped by the interspinous ligaments The direction of the needle is now checked and it is passed inwards with a very slight upwards direction keeping it strictly in the mid line Passage through the thecal membranes and entrance of the point into the subarachnoid space will be noted by a sudden and distinct lessening of resistance If the stylet is now withdrawn cerebro-spinal fluid issues from the needle which should be inserted a fraction farther to ensure that the whole of the bevel is through the membrane The syringe is attached and the injection slowly performed, after which a slight pause is made then syringe and needle together are

withdrawn The puncture in the skin is sealed with collodion

Methods of Administration

(a) *Low Spinal*—(1) The puncture is made in the sitting posture between 4th and 5th lumbar vertebræ Stovaine (Chaput's) is used and 0 5 c c injected the patient remaining upright for two minutes following the injection This produces a block from 2nd sacral segment downwards, and is suitable for operations on the anus and perineum (2) The puncture is made in the sitting posture between 3rd and 4th lumbar vertebræ. Stovaine 0 6 c c. is injected, the patient remaining upright for two minutes following the injection This produces a block from 5th lumbar segment downwards and is suitable for operations as above and also for cystoscopic examinations or operations

(b) *Medium Spinal*—The puncture is made in the lateral posture between 2nd and 3rd lumbar vertebræ Nupercaine 1 in 1 500 solution is used, and 12 c.c. are injected in females 14 c.c in males Following the injection, the patient is turned on to his face and the table tilted into 15° Trendelenburg After seven minutes the patient is turned on to his back and the operation is commenced the tilt of the table being maintained This method produces a block from 8th or 9th dorsal segment downwards and is suitable for operations on the inferior extremities or in the abdomen up to the level of the umbilicus

(c) *High Spinal*—The puncture is made in the lateral posture between 2nd and 3rd lumbar vertebræ Nupercaine 1 in 1 500 solution is used and 14 c.c are injected in females, 16 c c in males Following the injection, the patient is turned on to his face and the table tilted into 15° reverse Trendelenburg. At the same time the head piece is lowered so that the patient lies with his feet down and his head down the

highest point of the arch being at the level of the 2nd dorsal spine This position is maintained for five minutes, after which the table is tilted into 15° Trendelenburg, the patient turned on to his back, and the operation is commenced, the tilt being maintained throughout the operation This method blocks from the 5th dorsal segment downwards thus including the splanchnic fields, and is suitable for any operation in the abdomen up to the level of the diaphragm

Curare

Mode of Action —This drug is not an anæsthetic but interferes with the acetylcholine mechanism in the neuro-muscular junctions of skeletal muscle, producing a motor paralysis When injected intravenously, it rapidly causes paralysis of skeletal muscles producing an ideal relaxation for surgical procedures The diaphragm and intercostal muscles are affected last of all, so with control of injection respiratory inhibition should be avoided The drug is rapidly excreted the effect of the initial dose lasting from ten to thirty five minutes and repeat doses similarly When the maximum effect is present, laryngeal paralysis exists with absence of cough reflex, but this reappears before abdominal muscular relaxation wears off thus being a useful sign This also occurs with other reflexes, such as knee jerk or supinator reflex, and these may be tested as evidence of the effect wearing off, calling for a repeat injection

Indications —Operations on any type of patient when profound or prolonged muscular relaxation is required

Contraindications —Curare must not be given to the conscious patient If combined with ether the dose should be modified by a third as ether intensifies its action

Preparations —Intocostrin (Squibb), initial dose

40 milligrams, repeat dose 20 milligrams Tubo curarine Chloride (B W) initial dose 10 to 15 milli grams, repeat dose 5 to 10 milligrams

Method of Administration—Light anæsthesia is in duced to the second plane by means of cyclopropane nitrous oxide and oxygen or intravenous pentothal. Just before the operation commences, the initial dose of curare is given If relaxation is not produced *within three minutes the repeat dose should be given* and may be repeated at any time the effect shows signs of wearing off

Overdose—This produces paralysis of the diaphragm and intercostal muscles causing shallow jerky respirations or cessation of respiration altogether Artificial ventilation of the lungs with oxygen under pressure must be performed immediately and con tinued until spontaneous respiration commences Severe overdose should be treated with prostigmine intravenously in doses of not less than 5 milligrams followed by $\frac{1}{50}$ gr of atropine.

Emergency Situations

Respiratory Obstruction.—During induction, ob- struction by the lips or tongue or by spasm of the masseter can be prevented by the routine use of a dental prop or edentu lous oral prop During maintenance by hold ing the jaw forwards or inserting a pharyn geal or tracheal airway the tongue will be prevented from falling back. Tongue forceps should be used only in emergency the towel-clip pattern (Fig 220) being used in preference to the crushing clamp and applied in the horizontal plane



Fig 220.—Tongue forceps.

well back on the dorsum Should masseteric spasm occur in the absence of a dental prop, the obstruction may be relieved by passing a rubber tube through the nose into the pharynx If the tube is not available, gentle manipulation with a wooden wedge and Mason's gag must be tried care being taken not to loosen teeth Obstruction from laryngeal spasm producing stridor may be treated by the administration of carbon dioxide and oxygen, or by rhythmic traction on the tongue

Respiratory Failure.—Breath holding may occur during induction if ether, chloroform, or ethyl chloride is used The remedy is to reduce the strength of vapour and administer carbon dioxide True respiratory failure occurs from overdose In this case, the following routine must be adopted the head is lowered, all anæsthetic stopped, and carbon dioxide and oxygen given with artificial respiration If this does not succeed, Alpha lobelin ⅙ gr is injected subcutaneously or coramine 2 to 10 c.c intravenously

Cardiac Failure—This may occur during induction with chloroform or following respiratory failure from overdose of any anæsthetic If the patient is to survive the circulation must be re established within five minutes Speed is therefore essential and the sooner the heart is started again the more chance there is of a complete recovery

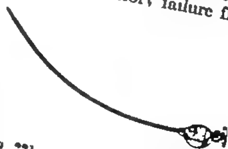


FIG 221—Auricular puncture needle.

Method of Resuscitation—The routine described for respiratory failure is followed If this does not succeed in producing a pulse within two minutes the

auricle is punctured with a needle (Fig 221) and cardiac stimulant injected Every cardiac stimulant has its special advocate, but the majority favour adrenalin The auricle is punctured by passing the needle (curved and 5 inches long) through the 3rd right inter costal space close to the sternum and directing it downwards and medially for 2 to 3 inches in children, 3½ to 4½ in adults If this manœuvre fails, the abdomen is opened and the heart massaged being grasped between fingers and thumb through the thickness of the diaphragm if possible, otherwise by making an incision in the diaphragm. Massage is performed by rhythmically squeezing the heart and is continued until strong contractions are established Throughout the efforts at resuscitation artificial respiration with oxygen and carbon dioxide must be performed

Shock.—The surest guides to the onset of this condition are the pulse and blood pressure A steady increase in pulse-rate with a fall in blood pressure denotes its approach Should the condition arise, the operation must be speedily finished stimulants such as coramine and intravenous saline plasma, or blood being given

Ether Convulsions.—This rare condition may occur in toxic patients in hot weather or when warmed ether vapour is being given It occurs in deep anæsthesia, and must not be confused with the innocuous tremors which frequently occur during induction and pass off when anæsthesia is established True ether convulsions commence with twitching of the facial muscles and gradually spread to the trunk and limbs, becoming more violent If untreated they may prove fatal If diagnosed in the early stages raising the head and administering carbon dioxide and oxygen may stop them If the convulsions persist or increase intravenous injection of evipan or pentothal results in immediate cessation

The Explosion Risk

Nitrous oxide, evipan, pentothal, avertin local spinal, trilene and chloroform are non-explosive anæsthetics Diethyl ether, divinyl ether, ethyl chloride and cyclopropane are inflammable and form explosive mixtures with air Mixed with nitrous oxide or oxygen the explosive propensities are greatly increased The sources of ignition are as follows naked lights actual or electric cautery, diathermy spark, exposed armatures on electric motors and diathermy machines faulty switches loose connections of terminals, loose or cracked bulbs on endoscopic lights, and some types of X ray apparatus In dry atmospheres, static sparking can occur from unearthed apparatus or by the movement of towels on the patient or table

Prevention.—In the presence of the explosion risk, non-explosive anæsthetics or a rigidly closed-circuit anæsthesia must be used Ether may be used for the induction, provided it is performed outside the operating theatre, as ether in the expired breath is non explosive Static sparking is prevented by adequate earthing of all apparatus and by moistening the atmosphere with steam

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